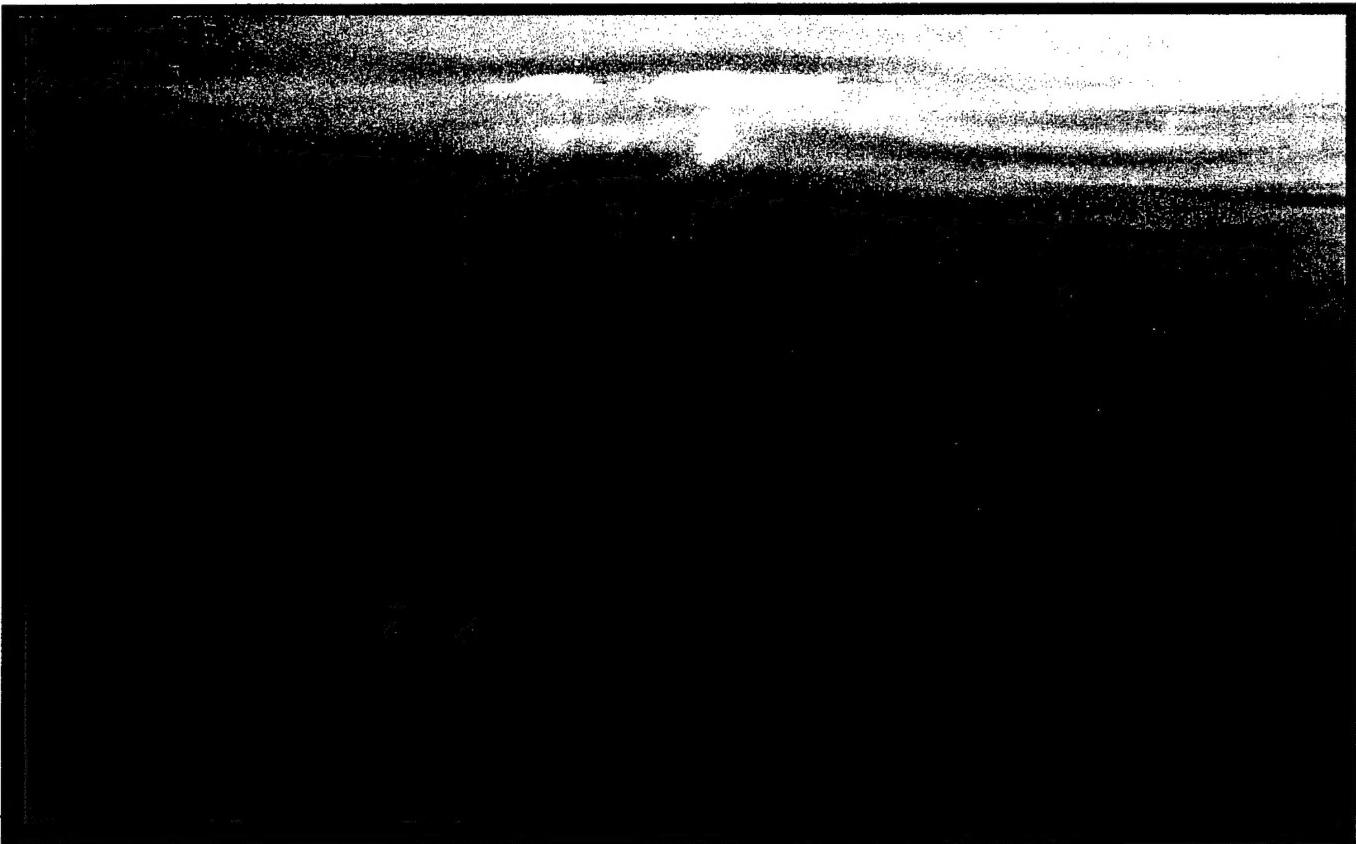




US Army Corps
of Engineers
Walla Walla District

Evaluation Report of Structures for Deer Creek Dam



Prepared For:
Nez Perce Tribe
April 1999

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EVALUATION REPORT OF STRUCTURES
FOR DEER CREEK DAM

Prepared for the Nez Perce Tribe

April 1999

EVALUATION REPORT OF STRUCTURES
FOR DEER CREEK DAM

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EVALUATION REPORT OF STRUCTURES FOR DEER CREEK DAM

EXECUTIVE SUMMARY

BACKGROUND.

The U.S. Army Corps of Engineers (Corps), Walla Walla District, by agreement with the Nez Perce Tribe (NPT), evaluated dam options for the Deer Creek Dam and High Falls Reservoir Project (Deer Creek Project) site. The Deer Creek Project site is located on Deer Creek in Lewis County, Idaho, and extends across sec. 18, 20, and 28, T. 32 N., R. 3 W., Boise Meridian. It is located on lands owned by the NPT in the heart of the Nez Perce National Forest. The site is approximately 12 miles west of Winchester, Idaho.

This work was funded on a cost-shared basis under the Corps' Planning Assistance to States and Tribes Program.

The purpose of this evaluation report is to identify and conceptualize features of the Deer Creek Project. The project features include access to the Deer Creek Project site, development of construction materials, and construction of the dam and appurtenant structures. This evaluation report is prepared at a reconnaissance level. It does not provide for design of the specific project features. Instead it identifies the options considered for selection and provides a clear development of the concept. The evaluation report develops a conceptual design for two dam options: homogenous earthen embankment dam and roller compacted concrete (RCC) dam.

DAM OPTIONS.

Embankment Dam Option. The embankment dam requires about 5 feet (ft) of freeboard for wave action and settlement and an additional 5 to 6 ft for discharge head over the emergency spillway. A low-level intake structure would be constructed upstream of the dam with a concrete pipe delivering water downstream through the dam and back into Deer Creek through an outlet structure. Should selective level withdrawal be required, a tower would be constructed at the intake. An overflow emergency spillway with a 150-foot crest length is proposed. The spillway could be constructed on the left abutment where a natural saddle would allow for an overland flow of water away from the embankment and back into Deer Creek downstream of the dam.

The RCC Dam Option. The RCC structure would incorporate an outlet system attached or embedded in the structure that incorporates a low-level gated inlet, a selective withdrawal system, and a self-regulating water surface "skimmer." The 150-foot-wide emergency spillway would be incorporated into the structure with spill over the top of the dam directly into Deer Creek downstream of the dam.

Both options were developed to meet the requirements of the NPT Ponds Project. The NPT Ponds Project is a fish stocking program to mitigate for anadromous fishery losses due to construction and operation of the Federal Columbia River Power System (FCRPS).

RECOMMENDATIONS.

Concept-level cost estimates show the total cost of the project ranges between \$5.0 million to \$6.3 million regardless of whether the structure is an embankment dam or an RCC dam.

Both structures are configured for minimal maintenance, unattended operation, and ease of construction. Consequently, the selection of the type of structure is not based on cost but should be based on other factors. Those factors include aesthetics, area disturbance, and operational and maintenance requirements.

A detailed design of the dam must include additional explorations to identify the unexplored rock intrusion in the foundation and to better characterize materials forming the spillway and the extremities of the dam structure.

EVALUATION REPORT OF STRUCTURES FOR DEER CREEK DAM

SECTION 1.0 - INTRODUCTION

1.01. GENERAL.

The Deer Creek Dam and High Falls Reservoir Project (Deer Creek Project) site is located on Deer Creek in Lewis County, Idaho, and extends across sec. 18, 20, and 28, T. 32 N., R. 3 W., Boise Meridian. It is located on lands owned by the Nez Perce Tribe (NPT) in the heart of the Nez Perce National Forest. The site is approximately 12 miles west of Winchester, Idaho.

The U.S. Army Corps of Engineers (Corps), Walla Walla District, by agreement with the NPT is performing an evaluation of dam options for the Deer Creek Project site. This work was funded on a cost-shared basis under the Corps' Planning Assistance to States and Tribes Program. This program was authorized by Congress in Section 22 of the Water Resources Development Act of 1974 (Public Law 93-251) as amended, and it authorizes the Corps to cost share with states and Tribes on a 50/50 basis for planning and conceptual design efforts to support comprehensive water plans. The Walla Walla District and the Nez Perce tribe entered into a cost-sharing agreement on June 8, 1998. The original scope of work included both the Deer Creek site and the Cold Springs site. Due to real estate issues, the NPT directed the Corps to discontinue efforts on the Cold Springs site.

The scope of the Walla Walla District work was to provide a concept-level design of viable dam options resulting in a recommended project configuration. In addition, a cost estimate is included from which to base future budget planning for the Deer Creek Project.

Site mapping and foundation and materials explorations for the Deer Creek Project were performed under separate agreements with Wyatt Engineering of Lewiston, Idaho, and GeoEngineers, Inc., of Spokane, Washington, respectively. The Corps provided assistance to the NPT in determining the scope of explorations work.

1.02. SCOPE OF THE EVALUATION REPORT.

The purpose of this evaluation report is to identify and conceptualize all the features of the Deer Creek Project. The project features include access to the Deer Creek Project site, development of construction materials, and construction of the dam and appurtenant structures. This evaluation report is prepared at a reconnaissance level. It does not provide for design of the project features. Instead, it identifies the options considered for selection and provides a clear development of the concept.

Several factors contributed to the selection and development of options upon which the construction cost estimate is based. The first factor is that experienced engineers performed several site visits. As a result of this activity and individual experience, the engineering elements of the Deer Creek Project were developed. The second factor is that information was developed that was critical to evaluating the foundation conditions and the nature and composition of site materials. The foundation and material explorations were performed by contract on behalf of the NPT. The third factor is that the Corps' experience in similar work was a basis for developing design features, construction quantities, and eventually a cost estimate.

This evaluation report documents the evaluation of two general types of dams: homogenous earthfill embankment and roller compacted concrete (RCC). Both are gravity dams constructed predominately with on-site materials and designed for operation under full and constant pool conditions. A conceptual development of all major design features of these dams is provided and a detailed breakdown of associated costs.

This evaluation report does not contain several elements normally considered part of a feasibility study. This evaluation report does not address environmental, economic, social, or cultural issues nor does it provide an incremental analysis of project costs and benefits. This evaluation report will become part of an NPT proposal for enhancement of resident fish mitigation programs.

1.03. BACKGROUND INFORMATION.

The Northwest Power Act (Act) empowers and requires the Northwest Power Planning Council (NPPC) to include measures in its Columbia River Basin Fish and Wildlife Program (Program) to address system-wide fish and wildlife losses resulting from construction and operation of hydropower dams. The Act further states that the NPPC may include in its Program measures that provide off-site mitigation (mitigation physically removed from the hydro-projects that caused the need to mitigate). The Program includes a goal "to recover and preserve the health of native resident fish injured by the hydropower system, where feasible and appropriate, to use resident fish to mitigate for anadromous fish losses in the system." The NPPC receives and reviews proposals to mitigate for fish and wildlife losses and refers approved measures to the Bonneville Power Administration (BPA) for funding.

Among measures recommended by the NPPC for off-site mitigation is the Nez Perce Trout Ponds Project. The Nez Perce Project is authorized under Sections 10.8D.2 of the NPPC's September 13, 1995, *Resident Fish and Wildlife Amendments to the Program*. Section 10.8D.1 authorizes the BPA to fund the NPT to implement resident fish substitution actions in the blocked area above Dworshak Dam to mitigate for losses of anadromous fish.

There are presently two NPT-use trout ponds within the NPT Indian Reservation: Talmaks with a surface area of about 4.0 acres; and Mud Springs, with a surface area of about 7.4 acres. By 2001, the NPT hopes to have constructed 10 additional impoundments for fish stocking. When all 12 impoundments are stocked, the combined annual harvest should be 10,500 pounds (lbs) of rainbow trout.

This evaluation report addresses 1 of the 10 additional fish impoundment projects. It focuses on the preliminary design and an impact analysis for the Deer Creek Project. The Deer Creek Project includes a dam that provides a reservoir of approximately 111 acres and a surface elevation 4,360 feet (ft) North American Vertical Datum (NAVD¹). This Deer Creek Project on the headwaters of Deer Creek (a tributary of the Salmon River) will create the High Falls Reservoir.

Following construction, the new fish pond will be incorporated into the fish stocking and monitoring programs. During subsequent years, beyond fiscal year 2006, there will be a persistent need for routine operation and maintenance, fish stocking, and environmental monitoring.

The Environment Assessment is being prepared by the BPA and the NPT to assess the environmental effects of the proposed Deer Creek Project.

1.04. PROJECT CRITERIA.

The dam options considered for the Deer Creek Dam Project will be a straight-axis gravity dam structure approximately 600 ft long at the top of the dam. The dam structure will be 80 ft high measured from the deepest point in the foundation. The hydraulic head is 70 ft measured from the assumed invert elevation of the streambed. The structures include an embedded 48-inch conduit that originates with a low-level outlet located upstream from the dam and terminates at an impact basin energy dissipater located downstream from the dam. An ungated, overflow spillway is sized to discharge a flow equal to one-half of the probable maximum flood of 5,800 cubic feet per second (cfs). Because of real estate constraints, the normal operating pool is fixed at elevation 4,360 ft. The overflow spillway crest regulates the pool elevation, and the low-level outlet is for infrequent reservoir drawdown required for inspection, maintenance, or emergency situations.

Numerous options are available for design of these structures and offer a wide range of cost and performance. It is crucial to match the project functional requirements with the most advantageous project option. The following considerations were evaluated to select the appropriate design features for an RCC dam: Unmanned operation, lowered-complexity of construction, relatively impermeable structure, and minimized project construction and operating cost.

Since a permanent operating staff would not be a resident at the project, it was determined that the Dam Creek Dam Project should operate with minimal

¹ All elevations in this report are based on the NAVD, 1988, unless otherwise specified.

staffing requirements. The reservoir water surface needs to be self-regulating. This requires that an overflow structure be provided at the desired water surface elevation and overflow water returned to the stream.

In order to secure as low a price as possible for construction, the design features and subsequent construction requirements should be appropriate for regional contractors. Selected design elements should use as many standard construction features as possible and include provisions to compensate for marginal construction conditions. Since the Deer Creek Project site is in a remote location, less complex operations usually require less mobilization of specialized equipment.

The Deer Creek stream flows are very low to nonexistent during the late summer months. Maximum normal spring flow (50 percent exceedance flow) is calculated to be 60 cfs during April and May. In order to maintain a full reservoir, it is critical that the structure and the foundation be relatively impervious. Measures to assure such performance are included in the proposed designs.

As is the case with many projects, costs must be at an absolute minimum. Proposed options are considered "no frills" and were selected, in part, because of their low cost.

SECTION 2.0 - HYDROLOGY

2.01. GENERAL.

The purpose of this section is to present the Deer Creek basin hydrology for the proposed Deer Creek Project. The following subjects will be addressed in this section: basin description, climate, stream flow information, flood frequencies, probable maximum flood, spillway design flood, drawdown capability, sedimentation, flood control, and dam break analysis.

2.02. BASIN DESCRIPTION.

The Deer Creek basin is located in the Salmon River basin and in Northwest Idaho. It has a length of 7.2 miles and an average stream slope of 120 ft per mile. The Deer Creek basin is roughly rectangular in shape, approximately 7 miles long and 4 miles wide. The drainage basin area at the Deer Creek Project is approximately 25.1 square miles. The stream flows from north to south. Approximately 70 percent of the basin is forested. The Deer Creek basin map is located in appendix C, map 2.

2.03. CLIMATE.

a. General.

The area has a temperate climate with moderate precipitation, cool moist winters, and warm summers. Mean annual temperatures characteristic of the area are approximately 45 degrees Fahrenheit. The average annual precipitation for the area is approximately 25 inches. Storms are not usually severe, but the area is subject to general storms and occasional thunderstorms. The storms most significant to stream flow are those that occur as general rainstorms on snow-covered frozen ground. Thunderstorms usually occur from late spring through the summer, seldom lasting more than a few minutes, and seldom cover large areas. Precipitation records are too sparse to show intensities received, but surrounding areas have a history of occasional flash floods from thunderstorms. Table 2-3 lists a summary of climatological data representative of Deer Creek. All climatological data summarized on table 2-3 was provided by the Idaho State Climatologist.

b. Precipitation.

The Deer Creek basin precipitation characteristics affect the basin's water supply, stream flows, and flood characteristics. The mean annual precipitation at nearby Winchester, Idaho, is approximately 24.2 inches per year and varies from 17 to 32 inches annually. A large portion of the precipitation during the winter months falls as snow. Table 2-1 lists precipitation and snow data for four nearby stations. These stations are shown on map 1 (appendix C).

c. Temperature.

Observed extremes in the locality have been -40 degrees Fahrenheit and 106 degrees Fahrenheit. Summer average temperatures range from 60 to 66 degrees Fahrenheit while winter average temperatures range from 27 to 33 degrees Fahrenheit.

2.04. STREAMS.

Deer Creek flows in a southerly direction. The Deer Creek basin elevation, at its headwaters, is above 5,100 ft National Geodetic Vertical Datum (NGVD) 1929 to an elevation at the Deer Creek Project site of approximately 4,290 ft NGVD.

2.05. DISCHARGE RECORDS.

Mean daily discharge records are available at the U.S. Geological Survey (USGS) gaging station as shown on map 2 (appendix C). The drainage area at this gaging station, located in the upper portion of the drainage, is approximately 19.1 square miles. This gaging station (Deer Creek near Winchester, Idaho, USGS station number 13317500) recorded daily discharges only for the period October 1, 1952, through November 30, 1956. The maximum discharge recorded at this gaging station was 209 cfs on April 16, 1956. There are two additional USGS gaging stations in the basin. These are Johns Creek near Grangeville, Idaho, and North Fork Skookumchuck Creek near White Bird, Idaho. These gaging stations have record periods of 1961 through 1972 and 1960 through 1971, respectively.

2.06. STREAM FLOW.

Daily stream flow records are available for Deer Creek for the period listed above in discharge records. For Deer Creek, the high flows for the year normally occur during the spring months and are caused by snowmelt. Lowest flows occur in the late summer and fall months. Large floods on Deer Creek usually result from general rainstorms or general rainstorm plus snowmelt. These floods may occur during the winter or the spring months. The area also has a potential for thunderstorm floods. A flow duration curve for April 1 through July 31 for the period of record is shown on chart 11 (appendix D).

2.07. CHANNEL CAPACITIES.

The channel below the dam flows through a steep canyon. This canyon will easily contain flows up to 11,600 cfs probable maximum flow (PMF).

2.08. TYPES OF FLOODS.

A combination of rain and snowmelt on frozen ground have produced the largest historical floods on Deer Creek. The records for Johns Creek near Grangeville, Idaho, and North Fork Skookumchuck Creek near White Bird, Idaho, do not indicate any major

thunderstorm activity in the area. Thunderstorm floods have produced relatively minor discharges.

2.09. UNIT HYDROGRAPHS AND FLOOD ROUTING.

Unit hydrographs were developed for six sub-basins of the Deer Creek drainage basin. The basin was so divided because the six tributaries run in opposing directions making a single basin length or centroid unrepresentative of the entire basin. The six sub-basins are West Fork Deer Creek, Larabee Meadows, Upper Deer Creek, Swamp Creek, Lower Deer Creek, and Rail Road Grade. These sub-basins are shown on map 2 (appendix C). Unit hydrographs were derived from Snyder's Synthetic Unit Hydrograph relations, reference Engineer Manual (EM) 1110-2-1417. Unit hydrographs and applicable parameters are shown on charts 2 through 7 (appendix D), respectively.

2.10. FLOOD HYDROGRAPHS.

Specific Flood Frequency Hydrographs were developed using the unit hydrographs shown on charts 2 through 7 (appendix D). The excess rates were the same used as for the Cold Spring Creek Drainage and precipitation from the National Oceanographic and Atmospheric Administration (NOAA) Atlas 2, *Precipitation-Frequency Atlas of the Western United States*, Idaho, 1973. Precipitation was arrayed as shown in figure 6-1(b) of the Hydrometeorological Report (HMR) 43.

Specific frequency point precipitation taken from the NOAA Atlas referenced above is shown in table 2-1.

Table 2-1. Specific Frequency Point Precipitation.

Recurrence Interval (years)	6 Hour (inches)	24 Hour (inches)
2	0.87	1.56
5	1.10	1.94
10	1.30	2.19
25	1.56	2.57
50	1.74	2.90
100	1.84	3.20

Excess rates were calibrated as described for Cold Spring Creek, a nearby drainage basin. Excess rates were applied to specific frequency precipitation and associated peak discharges were found by varying excess rates and matching expected probability discharges (see table 2-2).

Table 2-2. Excess Rate for Specific Frequency Floods.

Recurrence Interval (years)	Excess Rate (percent)
2	5.4
5	9.4
10	12.8
25	17.1
50	21.6
100	26.5
200	32.2
500	40.9

The Hydrologic Engineering Center Model HEC-1, Flood Hydrograph Package, dated 1998, was used to route sub-basin flows and determine specific frequency hydrographs and peak discharges. The annual peak discharge frequency curve shown on chart 1 (appendix D) was computed by fitting a Log Pearson Type III Curve through the specific frequency discharges for the above recurrence intervals.

2.11. PROBABLE MAXIMUM FLOOD.

The PMF estimate represents flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

The probable maximum precipitation, used for determining this flood, was developed using procedures outlined in HMR 43. The critical month was determined to be December, and the total probable maximum precipitation determined was 16.05 inches (8.50 inches of precipitation and 7.55 inches of snow melt). The precipitation was arrayed as shown in figure 6-1 (b) of HMR 43.

Losses were estimated to be initially one-tenth of an inch and 0.03 inches per hour thereafter. Arrayed probable maximum precipitation and excesses are shown on charts 8 (appendix D) and show inflow and outflow hydrographs for the RCC and embankment dam options.

The Hydrologic Engineering Center Model HEC-1, Flood Hydrograph Package, 1990, was used to determine the PMF hydrograph shown on chart 8 (appendix D).

In the case of this dam, one-half the PMF may be used for spillway design as outlined in the *National Program for Inspection of Non-Federal Dams*, Engineer Regulation (ER) 1110-2-106.

2.12. SPILLWAY DESIGN.

The spillway was designed using one-half the PMF peak discharge, 5,800 cfs. One-half the PMF was routed through the reservoir using an HEC-1 model. With the spillway crest at elevation 4,360 ft, the maximum pool elevation or surcharge for a 150-foot-wide spillway is approximately 4.3 ft and for a 100-foot-wide spillway 5.8 ft. The volume of one-half the PMF is large enough that starting water surface does not impact the final surcharge and peak flow for the spillway design flood.

2.13. WIND WAVE ANALYSIS.

Given the maximum fetch length of less than 1 mile, and the maximum wind speed of approximately 50 miles per hour from the PMF hydrometeorologic conditions, a maximum wave height of 3 ft was determined giving a maximum pool elevation 4,367.3 and 4,368.8 ft for the embankment and RCC dams, respectively. The maximum wave height was computed using Engineer Technical Letter Number 1110-2-305, *Determining Sheltered Water and Wave Characteristics*.

2.14. DRAWDOWN CAPABILITY.

The Deer Creek Project will be equipped with a low-level outlet that would be capable of drawing the reservoir down from elevation 4,360 ft to 4,333.2 ft in a period of approximately 30 days. The drawdown curve and referenced notes are shown on chart 10 (appendix D).

2.15. FLOOD CONTROL.

Flood Control was not evaluated.

2.16. SEDIMENTATION.

An estimated 400 acre-feet of sediment would accumulate in a 100-year time period. This estimate was made using engineering judgement. This volume corresponds to an elevation of approximately 4,329 ft. See the storage-elevation curve on chart 9 (appendix D).

2.17. DAM BREAK MODEL.

A dam break model was developed for the Deer Creek Project using the National Weather Service Dam Break Model, dated 1991. This model showed that a flood wave with a peak discharge of approximately 243,000 cfs would result from a near instantaneous dam failure. This flood wave was routed to the mouth of the Salmon River, approximately 20 miles downstream of the proposed Deer Creek Project site. Cross sections, graphs of stage, and discharge versus time are shown on charts 12 through 14 (appendix D). These represent the results of the dam break model at the Deer Creek Project, at the mouth of Deer Creek and at the mouth of the Salmon

River, respectively. A dam break flood inundation map is shown on map 3 (appendix C). Prior to constructing the project, the flood routing should continue down the Snake River until the flood hydrograph has been attenuated to a safe level.

2.18. TAILWATER RATING CURVE.

A tailwater rating curve was developed for a location at the toe of the proposed RCC dam. This rating curve is shown on chart 15 (appendix D).

Table 2-3. Climatological Data.

TEMPERATURE, DEGREES FAHRENHEIT									
Extreme Temperatures	Elevation ft	Maximum	Date	Minimum	Date				Period of Record
Cottonwood 2 WSW ¹⁾	3945	98	14 AUG 94	-20	03 FEB 89				FEB 50 - NOV 97
Grangeville	3360	106	04 AUG 61	-25	30 DEC 68				AUG 48 - NOV 97
Nez Perce	3145	104	04 AUG 61	-33	30 DEC 68				DEC 01 - OCT 96
Winchester 1 ESE ²⁾	3960	98	23 AUG 69	-40	30 DEC 68				JUL 65 - NOV 97

¹⁾ West southwest.
²⁾ East southeast.

AVERAGE MONTHLY TEMPERATURES									
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Cottonwood 2 WSW	29	33	39	45	51	59	62	59	52
Grangeville	28	33	37	44	52	58	66	66	57
Nez Perce	28	33	37	44	51	58	65	65	57
Winchester 1 ESE	27	31	35	41	48	55	61	61	53

PRECIPITATION, INCHES									
Record Precipitation	Elevation ft	Maximum	24-Hour	Date					Period of Record
Cottonwood 2 WSW	3945	2.10		23 JAN 82					FEB 50 - NOV 97
Grangeville	3360	3.01		14 SEP 55					AUG 48 - NOV 97
Nez Perce	3145	2.30		13 JUL 56					DEC 01 - OCT 96
Winchester 1 ESE	3960	2.12		15 AUG 93					JUL 65 - NOV 97

AVERAGE MONTHLY PRECIPITATION									
Average Monthly Precipitation	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Cottonwood 2 WSW	1.74	1.53	1.65	2.28	3.24	2.42	1.45	1.18	1.21
Grangeville	1.47	1.39	2.16	2.71	3.36	2.98	1.08	1.05	1.71
Nez Perce	1.71	1.33	1.79	2.22	2.91	2.31	1.13	1.21	1.33
Winchester 1 ESE	2.17	1.67	2.51	2.79	2.95	2.19	1.36	1.31	1.45

SNOW, INCHES									
Record Snowfall	Elevation ft	Maximum	24-Hour	Date					Period of Record
Cottonwood 2 WSW	3945	12		18 NOV 96					FEB 50 - NOV 97
Grangeville	3360	21		25 NOV 61					AUG 48 - NOV 97
Nez Perce	3145	13		14 FEB 66					DEC 01 - OCT 96
Winchester 1 ESE	3960	20		14 FEB 66					JUL 65 - NOV 97

SECTION 3.0 - GEOLOGY

3.01. GENERAL.

This section contains findings from the preliminary foundation investigations at Deer Creek Project site located on the NPT Indian Reservation in Lewis County, Idaho.

The NPT contracted GeoEngineers, Inc., to perform explorations at the site. The Corps defined the scope of explorations to be performed. Exploration data is compiled in a report prepared by GeoEngineers, Inc., *Geotechnical Exploration and Testing Proposed Deer Creek Reservoir, Lewis County, Idaho, January 8, 1999*. Four core holes were drilled approximately along the proposed dam alignment: two holes in the valley floor and one hole in each abutment. All of these holes were water pressure tested to evaluate foundation permeability. Additionally, one core hole was drilled at a potential on-site quarry location. Over a portion of the proposed reservoir area, 13 test pits were excavated. Laboratory physical properties testing was performed on test pit samples and petrographic analysis performed on various core samples.

3.02. SITE GEOLOGY.

a. Topography.

The proposed Deer Creek Project is located within a north to northwest trending valley containing Deer Creek. The valley floor ranges from 200 to 600 ft wide. The valley floor is 200 ft wide at the proposed Deer Creek Project. The slopes forming both the right and left abutments are about 3 horizontal (H) to 1 vertical (V), and the left abutment flattens out into a bench about elevation 4,370 ft. Slopes forming the valley sides are, in general, about 3H to 1V; however, in some local locations where rock crops out, slopes steepen to almost vertical.

b. Geology.

Three rock types of the Permian – Late Triassic Seven Devils Volcanics were mapped at the proposed Deer Creek Project site. The predominate rock type is an altered andesite. The andesite is intruded by a quartz diorite and, apparently, the andesite has been altered to an andesite cataclasite. Regardless, the contact between the andesite and quartz diorite is interpreted to be intrusive, while the cataclasite may be in fault contact with the andesite. Contacts with these three units underlay and run perpendicular to the proposed dam alignment. The rock in outcrop is moderately weathered on the surface and fresh and hard when broken. Bedrock outcrops, while few in number, appear to be mostly massive, in general, and are not indicative of the close-space fracturing found in the core holes.

c. Foundation Conditions.

Four core holes were drilled along the proposed dam alignment. Bedrock is encountered at depths of 4 to 9 ft on the valley floor and 0.5 to 3.5 ft in the slopes of the abutments. Core recovery was very good. The rock is generally fresh to slightly weathered and hard. The core is moderate to intensely fractured with fracture spacing close to moderate. Most fractures are tight but show evidence of water movement. Both core holes drilled in the abutments leaked during drilling, indicating high hydraulic conductivity through the abutments. All the core holes were water tested as they were advanced. At the base of and on the right abutment (RA), holes RA-1 and RA-2 showed high hydraulic conductivity to 80 ft in depth. At the base of and on the left abutment (LA) holes LA-3 and LA-4 showed a low hydraulic conductivity.

d. Reservoir Conditions.

Very little rock crops out in the proposed reservoir area. A weathered bedrock surface was encountered in most of the test pits and varied in depth from 4 to 8 ft below ground surface. Test pits were excavated with a backhoe to a depth of 4 to 10.5 ft with the majority about 9 ft deep. The soil mantle over the reservoir basin is silt and clay rich indicating low permeability.

e. Quarry Site.

One core hole was drilled to a depth of 80 ft at the proposed quarry location. The hole was cored on the down slope edge of the road and bedrock was encountered at 11 ft. The bedrock is fresh, hard, altered andesite. The rock is intensely fractured to a depth of 27 ft. The remainder of the hole is moderately fractured with fracture spacing of about 1 foot and a rock quality designation (RQD) of 80 to 100 percent. The hole was collared at the road edge at about elevation 4,324 ft, making the top of the bedrock at about elevation 4,313 ft, and moderately fractured rock at about elevation 4,297 ft. The valley floor is at about elevation 4,290 ft. The depth to bedrock of 11 ft at this location may be due to the hole being located on the outer edge of the road. The depth to bedrock may be only 4 or 5 ft if measured perpendicular to the slope below the road cut. From interpreting the core log and the topography at the core hole location, it appears that rock suitable for crushing or random rock fill is about 6 ft from the slope surface. At a depth of about 15 ft, rock of 8- to 24-inch size suitable for riprap would be encountered. Trenching on this slope would better define the depths to rock.

f. Ground Water.

No water level measurements were made in any of the core holes. Ground water was encountered and measured in test pits (TP) 1, TP-5, TP-8, TP-10, and TP-11. The test pits were excavated in September 1998 and the ground water level appears to be about 5 ft below the valley floor.

3.03. ENGINEERING CONSIDERATIONS.

a. General.

There is 0 to 9 ft of sand and gravel overburden along the proposed dam alignment. Stripping this material for the proposed structures would amount to common excavation of about 5,000 cubic yards (cy) of sand and gravel.

Core drilling indicated a fresh hard rock foundation that is intensely fractured. Fracture intensity decreases with depth. The bedrock foundation is mostly altered andesite with a minor portion being quartz diorite. Both of these rock types are strong, durable, and virtually incompressible in regards to the considered structures.

Cleaning the foundation to a depth that fracturing is reduced would be impractical. Where concrete structures will be constructed or impermeable fill placed, overburden should be removed (5,000 cy), and the foundation rock should be cleaned of all general loose materials to a depth of 1 to 2 ft, if necessary. Rock removal would amount to about 2,000 cy of material. Hard competent interlocked rock should not be removed. Overhung or vertical rock should be laid back to allow for earth embankment or RCC placement. In general, the maximum steepness in cut slopes in rock should be .25H to 1V and 1.5H to 1V in soil.

Excavations in the valley floor deeper than about 5 ft may require dewatering.

b. Foundation Grouting.

Due to the low annual flow in Deer Creek, water loss through foundation seepage cannot be tolerated. Due to the high hydraulic conductivity through the closely spaced open fractures in most of the foundation bedrock, a grout curtain will be required. Prior to final foundation cleaning, a single row grout curtain should be constructed in the dam foundation regardless of type of dam structure. Primary grout holes should be spaced at 40 ft, and it should be expected that the final closure holes could be down to a 5-foot spacing. The total depth of the grout holes should be no deeper than the total head expected in the reservoir. Therefore, for the 80-foot-high dam, grout holes would be approximately 80 ft deep.

c. Embankment Dam Option.

(1) Abutments and Foundation.

The overburden should be removed and the rock surface cleaned where the impermeable core of the dam will contact the foundation. The limits of excavation and cleaning are as stated above. A single row grout curtain should be constructed prior to final cleaning, as outlined above. Any shear area or open joints or fractures located within the zone under the impermeable core section of the

embankment should be identified. These areas should be cleaned then sealed off at the surface using a dental or surface grouting technique.

(2) Spillway.

The emergency spillway should be placed in the left abutment near the left end of the embankment dam. The natural topography on the left abutment levels off into a slight bench and saddle near elevation 4,370 ft allowing a reasonably easy excavation for an emergency spillway. The saddle would naturally direct water away from the embankment. The cut for spillway excavation could be started at about elevation 4,360 ft and extend in a northeast direction upstream from the alignment. The material excavated would be mostly bedrock. The depth of excavation at the back of the cut would be 12 ft with the rock back slope laid back at .25H to 1V. The soil mantle, if any, should be laid back at 1.5H to 1V. The excavation would remove approximately 8,500 cy of material. The excavation should be mostly common. However, without further exploration, assume for estimating purposes, 50 percent of the material will be removed by drill and blast.

The flows expected over the 150-foot-wide emergency spillway are expected to be of short duration and relatively low velocity. Given that the rock in general is fresh, hard, and intensely to moderately fractured, a concrete lined channel should not be necessary. However, the rock is fractured and erosion in the form of plucking could be a problem. Trenching in this area would better define the quality of the rock surface. To protect the rock downstream of the spillway from immediate erosion in a spill event, a 2-foot-thick sacrificial random fill could be placed over the bedrock 40 to 50 ft downstream.

d. The RCC Dam Option.

(1) Abutments and Foundation.

Overburden should be removed over the entire footprint of the dam structure. A single line, grout curtain should be constructed and the foundation cleaned, as described above.

(2) Spillway.

As much as 5,800 cfs could be released over the spillway. Again, the rock is hard and competent, but the fracturing may make it susceptible to plucking and headward erosion. Trenching in this area would better define the quality of the rock surface. Some type of stilling basin may be required to protect the foundation.

3.04. FURTHER INVESTIGATIONS.

To better define construction quantities and the dam foundation, additional subsurface exploration should be performed.

Two additional core holes should be drilled along the dam alignment. One should be placed higher on the left abutment in the vicinity of the proposed emergency spillway. The other hole should be an angled hole in the valley floor to explore the nature of the contacts between the quartz diorite, altered andesite, and the cataclasite.

Backhoe trenching should be performed in the vicinity of the proposed quarry, emergency spillway, and stream channel spill basin to determine depth to bedrock, surface rock quality, and depth of common excavation.

Values for hydraulic conductivity should be computed using the water test data.

3.05. CONCLUSIONS.

The rock foundation appears competent for either an embankment or RCC structure. A single row grout curtain is required to avoid seepage losses through the foundation and abutment fractures. The left abutment's topography is ideal for a natural emergency spillway.

SECTION 4.0 - SITE WORK ISSUES

4.01. GENERAL.

This section presents design criteria, design parameters, assumptions, and methods that will be used in preparing the civil design of the access roads for the Deer Creek Project.

4.02. DESIGN CRITERIA.

All design will be based on existing design parameters outlined in the following references and, in general, will conform to the following EM's, design manuals, and accepted engineering practices:

- a. EM 1110-2-410, *Design of Recreation Areas and Facilities - Access and Circulation*, December 31, 1982.
- b. American Association of State Highway Transportation Officials, *Policy on Geometric Design of Highways and Streets*, 1984
- c. U.S. Department of Transportation, *Manual on Uniform Control Devices*, 1988.

4.03. ROAD DESIGN.

a. Design Parameters.

Access will be designed for a truck/tractor/semitrailer combination (WB-40) that is representative of the majority of medium to large truck/tractor/semitrailer combinations that will be used for hauling material. It is not anticipated that vehicular parking will be required for the new facility at this time.

b. Access Requirements.

Access for construction is needed to the reservoir, the left abutment, and the right abutment. Permanent access, after the reservoir is filled, is needed to the left abutment. Access to the right abutment of the dam will be by crossing the dam. A section of the reservoir access road will remain available permanently for reservoir access and boat launching.

c. Existing Conditions.

The existing unpaved roads are impassible during wet weather. One of the keys to constructing this dam and using the reservoir is to make it accessible for both

construction vehicles and common light traffic. The existing roads are not considered usable in the current condition.

d. Improved Roads.

The existing roads must be leveled, graded, and compacted. Approximately 4 inches of base material with 2 inches of top course material to be placed and compacted is needed to upgrade the road section. This should provide an adequate foundation for vehicles to access the dam site. A single-lane road with turnouts every 2,000 ft is suggested. Plate 3 (appendix B) shows the locations of roads needed to be improved and new road sections that will be needed to connect them. By using existing roadway alignments and maintaining the single lane configuration, environmental damage in the area is minimized. However, as shown on plate 3, some construction roads will need to be two lanes to accommodate construction traffic.

4.04. STORM DRAINAGE.

In general, road grades will provide for surface runoff. An estimate of six culverts will be needed along the access roads. More hydraulic information will be needed to perform a complete design of the culverts needed along the road.

4.05. SIGNING.

Roadways will have directional symbols to guide traffic. Signs will be posted, as appropriate, for identification, safety, and provision of operating instructions.

4.06. SECURITY.

A limited access gate will be provided for the left abutment to restrict unwanted vehicular traffic. Pedestrian traffic will be allowed to cross the dam during normal spillway flows.

4.07. BORROW AREA.

Borrow materials can be obtained from a potential quarry approximately 1 mile from the dam site. This site has been used for minor rock materials for culvert repair. It is anticipated that adequate quantity and quality of rock is available.

4.08. CONCLUSIONS.

The prime factors in designing the roads were having adequate access to the site, environmental preservation, and cost. Costs were reduced by using only 6 inches of material for base and top course, using one-lane roads with turnouts, using existing roads/patterns as much as possible, and finding the most direct access possible. By using the existing dirt roads whenever possible, environmental effects were

minimized. Some new sections of road will be needed for the Deer Creek Project road.

SECTION 5.0 - HYDRAULIC STRUCTURES

5.01. GENERAL.

The hydraulic structures for the Deer Creek Project consist of a spillway for each type of alternative structure. The embankment dam utilizes a left abutment spillway excavated into a natural topographic bench. Spillway discharge flows overland to return to the stream channel. The RCC dam includes spillway centered on the dam structure. Both structures utilize a very similar outlet works. It consists of an intake tower with gates and controls, a 48-inch conduit, and an impact basin energy dissipater.

5.02. EMBANKMENT DAM SPILLWAY DESIGN.

The spillway will pass all normal overflow discharge up to the design flow of 5,800 cfs. Other reservoir discharge, such as draining for emergency maintenance, will be routed through the low-level outlet.

a. Features.

The spillway features are the approach channel, the formed concrete ogee (including the spillway crest), and the spillway chute. Due to the high level of energy dissipation in the chute, the embankment dam option does not require a separate energy dissipater.

b. Location.

The spillway will be located on the left abutment. The flat topography on this abutment will provide good spillway approach conditions with the least excavation. The left abutment also provides the shortest spillway chute, due to the alignment of the Deer Creek downstream of the dam site. Since the right abutment topography is much steeper, a 150-foot-wide spillway could not be practically located on this side. In addition, since the stream channel curves toward the left abutment downstream of the dam site, the spillway chute would be much longer if located on the right abutment. Therefore, locating the spillway on the left abutment requires the least site disturbance and has the lowest excavation cost.

c. Approach Conditions.

The spillway approach channel will be excavated to an elevation 4,355 ft, 5 ft below the spillway crest elevation 4,360 ft. The approach velocity will be under 6 feet per second (fps) for all flows up to the design discharge (5,800 cfs). The left bank of the channel will be excavated to an alignment perpendicular to the spillway crest (plate 5, appendix B). This will provide stable discharge conditions over the spillway up to the design flow rate.

d. Weir Geometry.

For ease of construction, the upstream face of the ogee will be vertical. The crest and downstream face of the ogee will follow standard ogee geometry for overflow spillways to provide an efficient spillway rating curve with a high discharge coefficient. The spillway is very wide in comparison to its design flow. The 150-foot-width spillway provides a low unit discharge (39 cfs per foot of spillway length) and a correspondingly low design head (4.4 ft). This minimizes pool fluctuation and energy dissipation requirements. It will also reduce resident fish loss, since the depth of flow over the weir crest will be very low. A typical spring runoff of 50 cfs will result in a flow depth of 3 inches over the spillway. It is expected that very few fish will be entrained at such a low depth, particularly given the low approach velocity (less than 0.1 fps for 50 cfs spillway flow).

e. Discharge Rating.

Due to the steep abutment slope (greater than .25 ft per foot), the spillway will operate unsubmerged up to and including the design discharge, 5,800 cfs. The discharge rating data for the 150-foot embankment dam spillway is shown in table 5-1.

Table 5-1. Discharge Rating for Embankment Dam Spillway Crest.

Flow Depth (ft)	Elev. ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. ft	Flow Rate (cfs)
70.0	4360.0	94.0	59.2	4349.2	86.4	49.2	4339.2	78.8
68.9	4358.9	93.2	58.1	4348.1	85.7	48.3	4338.3	78.1
67.8	4357.8	92.5	57.1	4347.1	84.9	47.4	4337.4	77.3
66.7	4356.7	91.7	56.1	4346.1	84.1	46.4	4336.4	76.6
65.6	4355.6	91.0	55.1	4345.1	83.4	45.5	4335.5	75.8
64.5	4354.5	90.2	54.1	4344.1	82.6	44.6	4334.6	75.0
63.4	4353.4	89.5	53.1	4343.1	81.9	43.7	4333.7	74.3
62.3	4352.3	88.7	52.1	4342.1	81.1	42.8	4332.8	73.5
61.3	4351.3	87.9	51.2	4341.2	80.4	41.9	4331.9	72.8
60.2	4350.2	87.2	50.2	4340.2	79.6	41.1	4331.1	72.0

f. Downstream Energy Dissipation.

The left abutment is composed of fractured basalt that is likely to withstand the anticipated spillway flow velocities with limited erosion. Typical spring flows will be 3 to 4 fps at a depth of up to 0.25 ft (4 inches). The 100-year flow will be 1,273 cfs, with a depth of 0.66 ft (8 inches) and a velocity of about 13 fps. It is recommended that additional exploration be conducted to confirm the nature of the fracturing and establish with more certainty the extent of erosion at anticipated spillway flows. The chute will be formed as the unimproved abutment erodes. It is expected to have a high hydraulic

roughness (Manning $n = 0.03$ to 0.07), capable of dissipating the energy of the spillway design flow without the need for a formed stilling basin. Flow from the spillway will re-enter the main Deer Creek about 350 ft downstream of the spillway crest. After formation, the spillway chute is expected to have a width of about 150 ft and a longitudinal slope of about 0.20 ft per foot. In larger flows, it is expected that some fish will be entrained over the spillway. A section of large riprap (greater than a 2-foot diameter) will be placed in the spillway chute to kill any resident fish that become entrained in large flows.

5.03. THE RCC DAM SPILLWAY AND STILLING BASIN DESIGN.

The hydraulic structures necessary for the RCC option are similar in function to the embankment dam. The location and configuration of the spillway and outlet have been altered to fit the requirements of the RCC structure.

The spillway will pass all normal overflow discharge up to the design flow, 5,800 cfs. Discharges related to draining the reservoir for emergency maintenance will be routed through the low-level outlet.

a. Features.

The spillway will be composed of a formed concrete ogee crest, an RCC spillway chute, and an RCC stilling basin.

b. Approach Conditions.

The spillway approach velocity will be negligible, since the spillway is located near the middle of the dam at the deepest part of the reservoir with the crest parallel to the dam axis.

c. Weir Geometry.

In order to minimize stilling basin excavation costs, the RCC spillway length will be 100 ft, 50 ft shorter than the embankment spillway length. This will increase the design head on the spillway by 1.5 ft to a maximum depth of 5.9 ft over the spillway crest for the design flow of 5,800 cfs. The crest and downstream face of the ogee will follow standard ogee geometry for overflow spillways to provide an efficient spillway rating curve with a high discharge coefficient. This will result in little loss of resident fish, since depth of flow over the weir crest will be low. A typical spring runoff of 50 cfs will result in a flow depth of 4 inches over the spillway. This is slightly higher than with the embankment option, but it is still expected that very few fish will be entrained at such a low depth.

d. Discharge Rating.

The RCC Spillway rating is based on a maximum discharge coefficient of 4.03, spillway crest length of 100 ft, and two end contractions. The discharge rating data for the 100-foot RCC dam spillway are shown in table 5-2.

Table 5-2. Discharge Rating for RCC Dam Spillway Crest.

Flow Depth (ft)	Elev. Ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. Ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. ft	Flow Rate (cfs)
0.0	4360.0	0.0	2.1	4362.1	1065.3	4.2	4364.2	3439.7
0.1	4360.1	9.0	2.2	4362.2	1152.8	4.3	4364.3	3562.5
0.2	4360.2	25.8	2.3	4362.3	1243.5	4.4	4364.4	3686.8
0.3	4360.3	48.0	2.4	4362.4	1337.4	4.5	4364.5	3812.4
0.4	4360.4	74.7	2.5	4362.5	1434.6	4.6	4364.6	3939.4
0.5	4360.5	105.5	2.6	4362.6	1535.0	4.7	4364.7	4067.7
0.6	4360.6	140.2	2.7	4362.7	1638.7	4.8	4364.8	4197.4
0.7	4360.7	178.5	2.8	4362.8	1745.6	4.9	4364.9	4328.3
0.8	4360.8	220.4	2.9	4362.9	1855.8	5.0	4365.0	4460.6
0.9	4360.9	265.8	3.0	4363.0	1969.3	5.1	4365.1	4594.2
1.0	4361.0	314.5	3.1	4363.1	2086.1	5.2	4365.2	4729.0
1.1	4361.1	366.6	3.2	4363.2	2206.2	5.3	4365.3	4865.1
1.2	4361.2	422.0	3.3	4363.3	2329.7	5.4	4365.4	5002.4
1.3	4361.3	480.6	3.4	4363.4	2456.4	5.5	4365.5	5141.0
1.4	4361.4	542.4	3.5	4363.5	2586.6	5.6	4365.6	5280.7
1.5	4361.5	607.5	3.6	4363.6	2720.1	5.7	4365.7	5421.7
1.6	4361.6	675.8	3.7	4363.7	2847.0	5.8	4365.8	5563.9
1.7	4361.7	747.3	3.8	4363.8	2962.6	5.9	4365.9	5707.3
1.8	4361.8	822.0	3.9	4363.9	3079.6	5.964	4366.0	5800.0
1.9	4361.9	899.9	4.0	4364.0	3198.2			
2.0	4362.0	981.0	4.1	4364.1	3318.2			

e. Chute Geometry.

The spillway chute will be the same width as the spillway crest (100 ft) with 7-foot-high training walls to accommodate the design flow and the anticipated air bulking due to high-flow velocity in the chute. Since the RCC chute will be rough and flows, generally, will be very shallow, it is expected that resident fish passing over the spillway will not survive or escape downstream.

f. Stilling Basin.

The spillway stilling basin will be 40 ft long with a flat apron, no baffle blocks, an endsill approximately 4 ft in height, and constructed of RCC. The tailwater

will be controlled by critical flow depth over the endsill, since the downstream channel slope is critical. The stilling basin floor elevation is set so that the tailwater elevation corresponds to 85 percent of the sequent depth, per standard Corps design procedure.

g. Downstream Channel Protection.

As with the embankment option, large diameter riprap will be placed downstream of the stilling basin to protect the downstream channel from erosion and to assure that any fish surviving the spillway chute will be prevented from entering the downstream channel.

5.04. OUTLET WORKS DESIGN.

The primary purpose of the low-level outlet will be to drain the reservoir if emergency maintenance is required. In addition, the outlet valve can be used to regulate outflow for other uses if limited reservoir volume must be released in controlled amounts. However, the slide-gate arrangement will not be ideal for throttling flow. The designs of the outlet works for the embankment dam and the RCC dam are very similar.

a. Flow Requirements.

The low-level outlet is designed to discharge an average of 84 cfs while draining 90 percent of the reservoir volume within a 1-month period. The design flow rate will permit the evacuation of the reservoir to elevation 4,333.2 ft in 1 month during typical high-flow conditions, assuming 34 cfs reservoir drainage and 50 cfs inflow. This will allow reservoir evacuation and maintenance work to occur in the same year, if necessary.

b. Intake Structure.

An intake tower in the forebay is necessary to assure open-channel flow through the embankment. This is required for an embankment dam because pressure flow could result in leakage that would damage the embankment. The tower in the forebay will have a flow entrance at elevation 4,330 ft (the 100-year sediment level). The tower will house a trash rack, two slide-gates, and an inlet-control orifice. These features will provide protection against debris and sedimentation and will assure the outlet pipe does not pressurize. The tower will be submerged but will have slide-gate operators above the high-water level. This will provide a low-cost structure with redundant gates and accessible gate operators to assure the ability to drain the reservoir even if one gate fails to operate.

c. Outlet Conduit Flow Control Entrances.

An ungated orifice at the entrance to the outlet pipe will limit the flow in the outlet pipe to assure open channel conditions at all times. The two gates located above the outlet pipe can be partially closed to further limit reservoir outflow, if necessary.

d. Outlet Conduit.

The outlet conduit will be sloped to assure open channel flow at discharges up to 100 cfs.

e. Energy Dissipater.

An impact basin will be located at the downstream end of the outlet pipe. The impact basin will dissipate the energy in the outlet pipe discharge. This will provide erosion protection for the downstream channel. In addition, to assure that no resident fish are released into the downstream channel, the slope of the outlet pipe will be adjusted so that high-velocity flow will enter the impact basin. This will cause a high level of energy dissipation within the impact basin and is expected to kill any resident fish that may be drawn into the pipe during a reservoir drawdown.

f. Discharge Rating.

The discharge rating of the low-level outlet is based on an orifice with cross-sectional area of 1.75 square ft and a discharge coefficient of 0.8. The orifice will discharge into open channel at all design flows. The discharge rating data for the outlet is shown in table 5-3.

Table 5-3. Discharge Rate for Low-Level Outlet.

Flow Depth (ft)	Elev. ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. ft	Flow Rate (cfs)	Flow Depth (ft)	Elev. ft	Flow Rate (cfs)
70.0	4360.0	94.0	59.2	4349.2	86.4	49.2	4339.2	78.8
68.9	4358.9	93.2	58.1	4348.1	85.7	48.3	4338.3	78.1
67.8	4357.8	92.5	57.1	4347.1	84.9	47.4	4337.4	77.3
66.7	4356.7	91.7	56.1	4346.1	84.1	46.4	4336.4	76.6
65.6	4355.6	91.0	55.1	4345.1	83.4	45.5	4335.5	75.8
64.5	4354.5	90.2	54.1	4344.1	82.6	44.6	4334.6	75.0
63.4	4353.4	89.5	53.1	4343.1	81.9	43.7	4333.7	74.3
62.3	4352.3	88.7	52.1	4342.1	81.1	42.8	4332.8	73.5
61.3	4351.3	87.9	51.2	4341.2	80.4	41.9	4331.9	72.8
60.2	4350.2	87.2	50.2	4340.2	79.6	41.1	4331.1	72.0

SECTION 6.0 - EMBANKMENT DAM

6.01. GENERAL.

The dam embankment will consist of an impervious center core supported with random fill shells. The core will have 1H on 1V slopes with a 12-foot top width and will be protected from piping by a downstream sand filter zone. The embankment crest will be approximately 80 ft above the foundation gravel in the valley floor. The core will be taken to the rock foundation, and a grout curtain will be installed beneath the dam.

6.02. DESIGN CRITERIA.

All design will be based on existing design parameters outlined in the following references and, in general, will conform to the following EM's, design manuals, and accepted engineering practices:

- a. EM 1110-2-2300, *Earth and Rock-Fill Dams – General Design and Construction Considerations*, July 31, 1994.
- b. EM 1110-2-1901, *Seepage Analysis and Control for Dams*, September 30, 1986.
- c. EM 1110-2-1902, *Stability of Earth and Rock-Fill Dams*, April 1, 1970.
- d. Bureau of Reclamation, *Design of Small Dams*, 1987.

6.03. EXPLORATIONS.

The NPT hired GeoEngineers, Inc., to perform exploration at the site. The Corps defined the scope of explorations to be performed. Exploration data is compiled in a report prepared by GeoEngineers, Inc., *Geotechnical Exploration and Testing Proposed Deer Creek Reservoir, Lewis County, Idaho*, January 8, 1999. Four core holes were drilled approximately along the proposed dam alignment: two holes in the valley floor and one hole in each abutment. These four holes were water pressure tested. Additionally, one core hole was drilled at a potential on-site quarry location. Thirteen test pits were dug over a portion of the proposed reservoir area. Laboratory testing was performed on test pit samples and petrographic analysis performed on various core samples.

6.04. LABORATORY TESTING.

The laboratory testing was also performed by GeoEngineers, Inc. No undisturbed sampling or testing was performed. Two composite samples were obtained from the test pits. The samples were visually classified, and Atterberg limits were obtained. The samples were compacted at or near 95 percent of the estimated

maximum dry density, and the following tests were performed. A consolidation test and shear strength test were performed on each sample, and one gradation test was also performed on the granular materials. Results of the laboratory testing can be found in the report by GeoEngineers, Inc.

6.05. FOUNDATION.

Generally, the site has overburden in the range of 0 to 9 ft in thickness. The overburden consists of clays and gravelly clays and sands. Those portions of the abutments contacting the core and filters will be trimmed to sound rock having a generally uniform slope estimated at 3 horizontal to 1 vertical. Excavation of the valley floor will be carried to approximately elevation 4,280 ft that will place the core on rock. The remainder of the valley floor will be stripped to a depth of 2 ft to remove overburden, brush, and trees from the surface. Grouting of the foundation will be required and must be completed in advance of embankment placement.

6.06. EMBANKMENT DESIGN.

The design is predicated on foundation conditions, borrow considerations, and stability analysis for various configurations of the embankment. There is adequate availability of impervious material in the proposed reservoir area. Therefore, the dam will have an impervious core in the middle section approximately 12 ft wide at the top with 1H to 2V side slopes. The filter zone on the downstream side of the core consists of 10 ft of horizontal width to facilitate construction equipment. The shell material will consist of the materials found in the reservoir area, consisting of sandy clays to clayey gravels. The downstream and upstream slopes will be protected by rock and cobble excavation from the spillway.

6.07. DESIGN STRENGTHS.

Design strengths for the core materials were determined from the triaxial shear and direct shear tests performed on sample number 1. Disturbed samples were remolded to 95-percent standard maximum density at optimum water content. Triaxial shear tests were conducted using unconsolidated, undrained shear test (Q tests) and consolidated, undrained shear test (R tests). Direct shear tests were used to determine the material consolidated, drained shear test (S tests). A summary of the design strength for the random fill materials are shown on table 6-1, and the core materials are shown on table 6-2. The design shear strengths for the gravel, sand, and riprap areas are conservative estimates based on references in the Bureau of Reclamation, *Design of Small Dams*.

Table 6-1. Slope Stability Design Values for Embankment Materials.

Material	γ_m ^{1/}	γ_{sat} ^{2/}	C ^{3/}	ϕ ^{4/}
Riprap	130	135	0	40
Sand Filter	125	-	0	33
Cobbles	127	130	0	35
Gravel	125	130	0	33
Nat. Ground	125	130	0	32
Rock	150	150	10000	50

^{1/} Material unit weight.

^{2/} Saturated unit weight.

^{3/} Cohesion pounds per square inch (PSI).

^{4/} Phi angle.

Table 6-2. Material Properties for Core and Fill Material from Laboratory Testing.

Material	γ_m	γ_{sat}	C	ϕ
Core				
S - Test	115	120	0	29
Q - Test			1160	8
R - Test			350	17
R' - Test			0	30
Fill				
S - Test	120	125	0	30
Q - Test			1580	9
R - Test			800	15
R' - Test			0	31

6.08. STABILITY ANALYSIS.

The upstream and downstream slopes were analyzed using the UTEXAS3 computer program for slope stability. The Spencer, Bishops, and Modified Swedish methods were analyzed using a circular failure mode. The design condition and resulting factor of safety is presented in table 6-3.

a. End of Construction.

Both upstream and downstream slopes were analyzed for this condition. The water table was assumed to be at ground surface. The Q strength was used for the core and fill material. The S strength was also tested for these materials.

b. Sudden Drawdown.

The upstream slope was analyzed for sudden drawdown from pool elevation 4,360 ft to pool elevation 4,330 ft (low-level outlet). The composite envelope for the R and S strengths was used as indicated in EM 1110-2-1902 for the core and fill materials. The S strength values were used for the granular materials

c. Steady Seepage.

The downstream slope was analyzed for steady seepage with a maximum operating pool and with a surcharge pool. An average of the R and S strengths was assumed for the core and fill materials. The assumed S strength values were used for the granular material. The failure surface for the minimum factor of safety was a shallow failure about 6 ft deep on the downstream slope. Since this is not a critical failure, a deep failure was forced on the program, and a higher factor of safety was obtained.

d. Earthquake.

There are no sand deposits to indicate a potential for liquefaction at the site; therefore, an earthquake analysis was not performed at this time. An analysis should be performed during the final design.

Table 6-3. Summary of Minimum Safety Factors.

Design Condition	Safety Factor
End of Construction Upstream	1.77
End of Construction Downstream	2.09
Sudden Drawdown	1.15
Partial Pool Upstream	1.69
Steady Seepage, elevation 4,360 ft	1.54 (Shallow Failure) 1.71 (Deep Failure)
Steady Seepage, elevation 4,365 ft	1.70

6.09. SEEPAGE CONTROL.

In addition to the impervious core, a grout curtain will be established beneath the dam. The details of connecting the grout curtain to the embankment will be established during development of plans and specifications. At this time, the location and seepage control for the conduit will also be established. The conduit will be placed so that there is a minimum of 18 inches of filter material around the downstream third of the conduit.

6.10. SETTLEMENT.

Two consolidation tests were performed on the remolded clays. A settlement analysis using this data indicates that a maximum of 1 foot of settlement can occur in the core and embankment materials. Additionally, the Bureau of Reclamation recommends that an additional 1 percent of the dam height be provided for settlement on relatively noncompressible foundations. Therefore, an additional 2 ft of height was added to the dam for settlement, making the top of the dam at elevation 4,370 ft.

6.11. SOURCES OF CONSTRUCTION MATERIALS.

The core materials will be obtained from the valley floor in the pool area. The clay material is approximately 5 to 6 ft thick within the first 400 ft of the proposed dam. The random fill material will also be obtained from the valley floor. The clay material is underlain by a clayey sand to clayey gravel approximately 4 to 6 ft thick. Additional clayey gravels can be obtained up the valley to the extent of the investigations. To prevent excess seepage, a minimum layer of 2 feet of clayey gravel material will remain above the rock within 100 feet of the upstream toe of the embankment. The rocks for the slope protection will be obtained from the spillway excavation. The sand filter material will be crushed on-site.

6.12. FURTHER INVESTIGATIONS.

To better define construction quantities and the design values for the embankment materials, additional subsurface exploration should be performed. Two Standard Penetration Tests should be performed beneath the proposed embankment to determine soil properties and settlement characteristics of the existing overburden. Backhoe trenching should be performed in the vicinity of the proposed borrow pit to establish the amount and content of the borrow available. Additional testing should be performed on compacted samples from the test pits to determine the properties for the random fill.

6.13. CONSTRUCTION SCHEDULE.

Appendix E summarizes the tasks and schedule for performance of the dam construction.

SECTION 7.0 - ROLLER COMPACTED CONCRETE DAM

7.01. THE RCC AND STRUCTURAL DESIGN ISSUES.

a. Design References.

For the evaluation of this structure, stability analyses were not done. The construction constraints of the RCC dam result in a structural geometry that meets all the stability requirements. During final design (in conjunction with the preparation of plans and specifications), all loading conditions should be considered in order to verify and document that the structure is stable.

The design is based on accepted engineering practices. The following publications are used:

- (1) American Concrete Institute (ACI) 318-83, *Building Code Requirements for Reinforced Concrete*.
- (2) American Institute of Steel Construction (AISC), *Manual of Steel Construction*, Eighth Edition.
- (3) EM 1110-2-2000, *Standard Practice for Concrete for Civil Works Structures*, Change 1, February 1, 1994.
- (4) EM 1110-2-2200, *Gravity Dam Design*, June 30, 1995.
- (5) EM 1110-2-2400, *Structural Design of Spillway and Outlet Works*.
- (6) EM 1110-2-2902, *Conduits, Culverts, and Pipes*, October 31, 1995.
- (7) ER 1110-2-1806, *Earthquake Design and Evaluation of Civil Works Projects*, July 3, 1969.
- (8) Engineer Technical Letter (ETL) 1110-2-256, *Sliding Stability for Concrete Structures*.
- (9) ETL 1110-2-265, *Strength Design Criteria for Reinforced Concrete Hydraulic Structures*.
- (10) ETL 1110-2-303, *Earthquake Analysis and Design of Concrete Gravity Dams*.

b. Dam Section Structural Analysis.

Loading conditions (all of which are of short duration and infrequent occurrence) considered appropriate for the project will be taken from EM 1110-2-2200. Uplift will be assumed to vary in a straight line from full pool head at the heel to full tailwater head, if any, at the toe.

Design for earthquake loads will be investigated using the seismic coefficient method. The project is located in seismic Zone 2 where only moderate damage is normally considered probable, but local faulting is expected to be capable of inducing higher accelerations than the $0.1g^1$ tabulated in ER 1110-2-1806. Because flooding and earthquakes are rare events, it is not considered reasonable to assume simultaneous occurrence. The combination was not considered in the stability analysis.

Final design of this structure requires a cracking analysis to be performed to verify that the anticipated mass volume changes can be accommodated by the materials and the jointing. The structure includes minimal jointing because materials will be designed to minimize volume changes, and the use of a membrane-type water barrier reduces the effects of transverse joints. The intent of this study is to estimate material properties and apply external boundary conditions that are considered reasonable worst case conditions. If the results show satisfactory or acceptable thermal performance, additional study and thermal control are not warranted.

c. Other Concrete Structures.

Conventional concrete will be used for the construction of the spillway cap, training walls, conduit encasement, outlet tower and impact basin, lift joint bedding, and foundation bedding.

Reinforced concrete structures will be designed with the design strength method in accordance with the current ACI Building Code, except as modified by ETL 1110-2-265. Design strength (f'_c) of conventional concrete is generally 4,000 psi at 28 days. Allowable stress in reinforcing steel will be limited to 20,000 psi in hydraulic structures.

Structural steel will be American Society for Testing and Materials (ASTM) A36. Working stresses for hydraulic structures will be based on percentages of allowable stresses indicated in AISC for gates, bulkheads, and stoplogs.

The corrugated metal pipe (CMP) diversion conduit upstream of the dam will be designed for loadings from external soil and acting hydrostatic pressures according to EM 2220-2-2902. Under the body of the dam, the smooth pipe diversion/outlet conduit will be designed to withstand collapsing pressures from pore water or seepage. Pipe thickness for the outlet is not fixed by structural considerations.

¹ Mean acceleration.

Concrete encasement to carry construction loads will be provided below the body of the dam for all conduits.

7.02. CONSTRUCTION MATERIALS.

a. Quantities.

Estimated quantities for both conventional concrete and RCC are shown in table 7-1.

Table 7-1. Estimated Concrete Quantities.

Conventional Concrete	Quantity
Foundation Dental Concrete	200 cy
Spillway Crest and Training Walls	230 cy
Stilling Basin Training Walls and Endsill	214 cy
Intake Tower	56 cy
Impact Basin	22 cy
Conduit Encasement	83 cy
Roller Compacted Concrete	
Mass RCC	45,000 cy
Stilling Basin Invert RCC	400 cy

b. The RCC Materials.

(1) On-site Aggregates.

A rock source from which to produce RCC aggregate has been identified on the left abutment just upstream of the dam. If the left abutment spillway is selected for RCC, rock excavation from that construction will be used for a portion of the RCC aggregate. The quarry will be configured so that all the rock excavation will be done below the normal water surface elevation, negating the need to do quarry restoration. Initial evaluation of rock for use as RCC aggregate was done during the exploration phase. GeoEngineers, Inc., performed foundation drilling and core removal to characterize the foundation. One additional drilled core was removed from the quarry location. Samples of the rock core were sent to Construction Technologies Laboratories for petrographic evaluation. The evaluation concluded that the rock is good quality and a viable material for use as RCC aggregate. A preliminary combined aggregate gradation for the 2-inch maximum size aggregate (MSA) is anticipated. Gradation modifications may occur during mix design studies, based on mix performance. The inclusion of nonplastic fines of 3 to 6 percent passing the 75 micron standard sieve is anticipated. Future work to be done includes the performance of

aggregate processing and mix design studies that are required for this new undeveloped source.

(2) Off-site Aggregates.

Because of the remote location of the site, extensive use of commercial aggregates is not anticipated. Certainly, on-site processing will be done for the large quantity of RCC aggregates. Some of the conventional concrete placements may use commercially produced aggregates. It is likely that aggregates would be hauled to the site and batched on-site with other materials for conventional concrete. While no commercial suppliers of aggregate exist in the immediate vicinity, rock crushing is done routinely in the area for surfacing roads. Test pits in the reservoir indicate that sand may be produced from on-site deposits.

(3) Cementitious Materials.

Portland cement (conforming to ASTM C 150, type II, low alkali, with the heat of hydration limited to 70 calories per gram) will be used for all RCC mixtures and other on-site batched mixtures. Cement used in conventional concretes batched at local concrete suppliers and used for non-mass placements will not have the heat of hydration limitation. Cement meeting these requirements is available in the region. Pozzolan (conforming to ASTM C 618, class F) may be used as a cement replacement for the RCC mixes at a replacement rate of 30 to 50 percent by volume. Bedding mixes and selected conventional concrete placements will also contain pozzolan at cement volume replacements not exceeding 40 percent, depending on the mix requirements. No chemical admixtures are anticipated for the Deer Creek mixtures.

(4) Mixing Water.

Water for concrete and RCC production is available from surface water. Ground water may be a viable option; however, no active wells exist in the vicinity of the construction site. The effects of water on properties of concrete should be investigated during production of mix design trials.

(5) Mixture Proportions.

Several RCC mixes are anticipated for Deer Creek Project construction. The mass RCC mix constitutes the largest volume of RCC (consisting of a lean mix proportioned for minimal heat generation and maximum aggregate size). The stilling basin surface will be a higher strength mass mix proportioned to have 1 year compressive strengths in excess of 3,000 psi with a maximum aggregate size of 1 1/2 to 2 inches (see table 7-2).

Table 7-2. The RCC Mix Composition.

Mix Designation	Cement (lbs/cy)	Fly Ash (lbs/cy)	MSA (inch)
RCC Mass Mix	120	60	1 1/2
RCC Stilling Basin Mix	200	100	1 1/2

The contract requirements will be based on actual mix performance, not minimum required performance. The minimum design strength of the mass mix at 1 year is estimated to be less than 1,500 psi. However, mix proportioning will result in mixes having 1 year compressive strengths of 2,000 psi.

7.03. THE RCC PRODUCTION AND PLACEMENT.

a. Aggregate Processing.

The quarry is located on the left abutment. Approximate limits are shown on plate 3 (appendix B). Specifications will require aggregates to be produced and stockpiled into at least two size groups with a possible additional separate stockpile for blend sand. Contract specifications will require that 75 percent of the RCC aggregate be produced prior to the start of RCC placement, and the remaining 25 percent produced prior to the placement of 50 percent of the RCC. Aggregates will be stockpiled into a minimum of three size groups: two coarse aggregate and one fine aggregate. Blend fines may also be stockpiled separately.

b. Plant Requirements.

The RCC batching and mixing plant must be capable of producing a sustained peak production rate of 150 cy per hour to sustain the maximum reasonable capability of the field placement crews and equipment. This requires a plant that has a rated capacity of approximately 200 cy per hour. At 150 cy per hour plant production and 20 working hours per day, the maximum rate of dam rise is approximately 6 ft per day.

c. The RCC Placement.

For a dam of this size and access limitations, only a few options to transport RCC exist. Vehicle hauling of RCC from the plant to the placement should not be allowed because serious contamination and lift surface degradation are likely. Conveying RCC to the placement site is the only practical method of transport. At the placement site, the material may be transported to its final location by conveyor or by front-end loader. The anticipated design and construction requirements for this structure will allow front-end loader transportation for this project.

The RCC will be deposited and spread into uniform layers approximately 12 inches thick by the front-end loader. A small dozer, similar to a Caterpillar D3 is

suitable for spreading RCC at the specified production rate. Compaction will be done by vibratory rollers, providing a minimum total dynamic force of 500 pounds per lineal inch of drum width and a minimum vibration frequency of 1,700 vibrations per minute (vpm). A double vibrating drum and a self-propelled, 10-ton vibratory roller easily meet this specification. The contractor will be required to provide compaction exceeding 98 percent of the maximum wet density of the RCC measured during each test section. It is recognized that gradation variations and inherent proportioning variation may affect the actual field maximum density.

Moist curing will be required on the exposed horizontal surfaces of the RCC. Formed surfaces such as vertical faces using conventional concrete will receive a membrane curing compound seal. Paneled surfaces will not be cured. The sloped surfaces of the RCC will receive a continuous application of moisture. A continuous application of moisture will be required on the exposed top surfaces of the RCC during construction. While this provides adequate curing, the primary benefit is to promote lift joint bonding. The manual application of spray water will be done from hoses located at several points on the upstream and downstream faces of the structure. Since the structure has a maximum length of 600 ft and a width of 100 ft, a minimal number of hoses and outlets will be required.

d. Joints and Joint Treatment.

(1) Contraction Joints.

The principal function of contraction joints is to limit the zones of significant foundation restraint to the lower regions of the dam, thereby, restricting potential cracking to those regions in the mass. Theoretically, the contraction joint spacing can be reduced to a point where no cracking will occur. Thermal studies will dictate the extent of contraction joint construction

(2) The RCC to Foundation Rock Joint.

After excavation, cleaning, and placement of dental concrete, the rock to RCC contact surfaces will receive an application of a conventional concrete bedding. This bedding concrete will be a high slump, 3/4 inch MSA, high sand content, and highly retarded mix. The purpose of the bedding concrete is to develop shear sliding resistance at the RCC to rock contact. The concrete will be spread as thin as possible (about 1 inch in thickness) across most rock contact surfaces. The foundation bedding concrete thickness will be increased to about 6 inches and the workability decreased for placement against significantly sloped and irregular rock surfaces.

(3) The RCC Lift Joints.

Shear properties along the RCC lift surfaces are anticipated to be 20 psi cohesion assuming a minimum friction angle of 45 degrees. Static stability and seismic analyses will need to be done to confirm the required material properties for the

actual structural configuration. For conditions where shear performance is below requirements, the use of bedding mortar applied to the surface is an acceptable solution. Mix design studies should include the determination of lift joint shear strength values for the Deer Creek mixes.

e. The RCC Slopes and Formed Faces.

(1) Upstream Face of Dam.

Vertical faces for RCC are required at the upstream face of the dam. While vertical facings can be constructed by extruded curb techniques or movable forming systems, cost estimates show that precast panel systems continue to be the most cost effective method for structures of this size and configuration. At the upstream, a precast panel system is to be installed from abutment to abutment. Each panel will contain several embedded bar straps through which bent anchor bars will hook and anchor the panel to the RCC fill. This anchorage allows vertical flexibility in the placement of RCC while anchor bars provide a positive anchor for the panels. During panel installation and adjacent RCC placement, strongbacks will be installed that will provide horizontal restraint and an alignment guide for the panels.

A PVC membrane is attached to each panel during the fabrication process. During panel installation, the PVC is welded at each panel joint to produce a continuous impervious membrane at the upstream face of the dam.

(2) Downstream Face of Dam.

The downstream face of the dam is to be the natural slope formed by placing RCC. The surface will be trimmed with an excavator during placement to maintain a uniform appearance.

7.04. MISCELLANEOUS ISSUES.

a. Spillway and Training Wall Segments.

The stilling basin consists of an invert slab construction of RCC. The thickness of the slab will depend on the uplift forces and the extent of anchoring. The slab is bounded on the downstream with a conventional concrete endsill and on the sides with conventional concrete training walls. Construction of the endsill may precede RCC placement. Construction of the training walls will follow RCC placement. The spillway chute is bordered by conventional concrete training walls. The construction of these walls will follow RCC placement. The overflow crest and approach apron of the spillway is also constructed of conventional concrete placed after completion of RCC placements.

b. Instrumentation.

Instrumentation may consist of several piezometers located on and adjacent to the structure. Horizontal movement of the structure can be monitored by survey methods from several monuments located along the reservoir in the vicinity of the dam.

c. Internal Gallery.

A gallery is not to be constructed in the dam. Because of the relatively low RCC volume, the construction of a gallery is costly and can be eliminated by proper design. Alternate approaches to installing grout curtains can be done and designs can accommodate few or no drains.

7.05. CONSTRUCTION PHASE.

a. Safety Issues.

This discussion is not intended to encompass all the safety issues at the Deer Creek Project site during construction but to highlight some of the more obvious considerations. The downstream face of the RCC overflow and nonoverflow sections will not be formed and will have a design slope of .9H to 1.0V. As the placement progresses, the section width becomes narrower, creating a vehicle congestion problem and pedestrian hazards. Portable guardrails will be attached to the panels or forming system on the upstream face and embedded into the RCC on the downstream face. Preventing vehicles from driving off the face of the dam is difficult to achieve, therefore, "safety zones" will be implemented. Rollers will not be allowed to compact material within 3 ft of the downstream face. Compaction will be done by manually-guided equipment.

b. Quality Control/Assurance.

It is recommended that adequate field staff be provided to implement a quality assurance program. Specifications should be clear as to what the contractor's requirements are for instituting and maintaining a quality control program for construction. The specifications will require that the contractor's quality control testing be provided by an independent, qualified materials testing organization. Numerous operations for both conventional concrete and RCC will require quality control and assurance measures. A typical staff for a project of this magnitude (assuming the construction is to be done during two shifts) is show below:

- Project Engineer
- Technical Representative
- Materials Technician
- Materials Assistant
- Two Field Inspectors

c. Construction Schedule

Appendix E summarizes the tasks and schedule for performance of the dam construction.

SECTION 8.0 - PROJECT COSTS

8.01. GENERAL.

Construction costs were developed from the engineering designs for this evaluation report and are based on the scope of work, assumptions, and methodology presented. Estimates were completed for two options: an earthen embankment dam and an RCC dam. This evaluation report documents the assumptions and quantities used in the concept estimates for the construction efforts involving the reservoir, access roads, and dam.

8.02. METHODOLOGY.

Conceptual level cost estimates (appendix A) were developed for each of the two options. The cost estimates include costs for construction contracts, engineering and design services, construction management services, and overall project management. Construction costs were prepared using the Tri-Service Automated Cost Engineering System (TRACES) software. The estimate is based on a work breakdown structure (WBS) that was developed at seven levels as follows: project, feature, subfeature, element, bid item, assemblies, and detail.

The major assumptions used in preparing the estimate are as follows:

- No fish passage around the projects will be maintained during and after construction.
- The rock sources identified will provide sufficient quantity and quality of material.
- The water sources identified will provide sufficient quantity and quality of water.
- Other assumptions are documented in the detailed estimate.

Because of the short construction season at the Deer Creek Project site, overtime is required for portions of this estimate. Specifically, it is required for production, transportation, and placement of rock, fill, RCC, concrete, riprap, and excavation of the embankments. Work hours for these tasks were assumed to be two 10-hour shifts per day, 6 days a week. Sand and gravel required for the various construction efforts is assumed to be available within 1 mile of the dam site. It is assumed that rock and riprap can be quarried from the spillway excavation or a quarry adjacent to the spillway excavation.

The present access roads are Lewis County Roads that need to be improved by regrading and installing crushed rock surfacing.

The present wooded and meadow areas, within the reservoir, need to be ready for the impounding of water behind the dam. The trees and brush need to be removed and disposed.

The estimates are based on use of common equipment and standard construction techniques in dam construction. Equipment is assumed to be available on the West Coast and is reflected in the mobilization/demobilization costs. A sufficient labor force is assumed to be available in the Lewiston, Idaho/Clarkston, Washington, area.

8.03. BASIS OF ESTIMATE.

Costs are based on a typical contract bidding process. The estimate assumes three contracts would be awarded separately. One contract will be awarded for the access roads, another for the reservoir preparations, and the third for dam construction. More efficient contract combinations may be possible when work tasks are better developed. The determination of the number of contracts will ultimately depend on the schedule of work and the cost effectiveness of contract combinations.

Markups (e.g., field office overhead, home office overhead, and profit and bond) were applied to the proposed prime contractors and subcontractors. Tribal Employment Rights Ordinance (TERO) tax was also included. Rates used were based on historical averages for similar-sized jobs.

Escalation was calculated to reflect the cost of inflation using EM 1110-2-1304, *Civil Works Construction Cost Index System (CWCCIS)*.

The estimate uses Davis-Bacon Labor.

Equipment rates are from Engineer Pamphlet 1110-1-8, Volume 8, September 1997, *Construction Equipment Ownership and Operating Expense Schedule*.

Construction costs were prepared using the U.S. Army Corps of Engineers, *TRACES, Unit Price Book 1999*, prepared by R.S. Means Company, Inc.

Contingencies were developed in accordance with the contingency guidance provided in ER 1110-2-1302, *Civil Works Cost Engineering*.

8.04. PROJECT COST SUMMARY.

The total project cost for the Deer Creek Project using an embankment dam, is estimated at \$5.68 million. This includes contingency, engineering, construction management, and escalation to the midpoint (July 1999) of construction.

The total project cost for the Deer Creek Project using an RCC dam, is estimated at \$6.38 million. This includes contingency, engineering, construction management, and escalation to the midpoint of construction.

SECTION 9.0 - CONCLUSIONS

9.01. HYDROLOGY.

- The spillway is sized for one-half of the PMF at 5,800 cfs.
- Wave height is calculated at 3 ft.
- Drawdown capacity is set at 30 days to evacuate to elevation 4,330 ft during peak flows.
- The 100-year sediment accumulation is estimated at 400 acre-feet.
- No additional modifications are needed to accommodate a dam-break flood routing.

9.02. GEOLOGY.

- Dewatering for excavations deeper than 5 ft in the valley floor may be required.
- A single line grout curtain will be sufficient for foundation treatment.
- The left abutment provides an ideal location for an auxiliary spillway.

9.03. ACCESS ISSUES.

- The road between Soldiers Meadow Road and the Deer Creek Project site needs to be upgraded to an all-weather road and turnouts added.
- Sections of new road are required.
- Construction of the project requires that road improvements be made during the construction season prior to dam construction. This allows early start for construction of the dam features.

9.04. HYDRAULIC STRUCTURES.

- The embankment dam includes a left abutment spillway with a 150-foot-long overflow adequate for reservoir water surface control. A downstream rock apron will provide a trap for escaped fish.
- For the RCC dam, a 100-foot overflow spillway centered on the structure will provide a reservoir water surface control. A downstream rock apron will provide fish trap.
- Intake structures are provided for low-level outlet capability and for special water surface control measures.
- An impact basin provides energy dissipation for outlet conduit.
- Stream diversion can be provided by an impoundment berm and CMP piping, or use of an outlet conduit, or a combination.

9.05. EMBANKMENT DAM.

- Sufficient materials are available in the reservoir area to construct an embankment dam.
- The embankment dam is to be primarily impervious fill with filters and shell. The top of the dam is set at elevation 4,370 ft. The section is stable against slope failures for sudden drawdown and earthquake with an upstream slope of 2.5H to 1V and the downstream slope of 3.0H to 1V.

9.06. THE RCC DAM.

- Sufficient materials are available in the reservoir area to construct an RCC dam.
- The RCC dam has a vertical upstream face and a 1V to 0.9H downstream slope. An impervious poly-vinyl chloride (PVC) membrane is incorporated into the upstream face construction.

9.07. PROJECT COST.

- The total project cost for the Deer Creek Project, using an embankment dam, is estimated to be \$5.0 to \$6.3 million. This includes contingency, engineering, construction management, and escalation to the midpoint of construction.
- The total project cost for the Deer Creek Project, using an RCC dam, is estimated at \$5.0 to \$6.3 million. This includes contingency, engineering, construction management, and escalation to the midpoint of construction.

SECTION 10.0 - RECOMMENDATIONS

Concept-level cost estimates show the total cost of the project ranges between \$5.0 million to \$6.3 million regardless of whether the structure is an embankment dam or an RCC dam. Both structures are configured for minimal maintenance, unattended operation, and ease of construction. Consequently, the selection of the type of structure is not based on cost but should be based on other factors. Those factors include aesthetics, area disturbance, and operational and maintenance requirements. It is recommended that during the design phase of the project, Tribal goals and concerns be more fully developed in order to establish which structure best meets the needs and operational mode of the Tribe.

A detailed design of the dam must include additional explorations to identify the unexplored rock intrusion in the foundation and to better characterize materials forming the spillway and the extremities of the dam structure.

Additional test pits are necessary to better quantify and qualify material sources for the various fill, core, and rock materials used for both structures. Additional materials testing will be necessary to characterize the range of materials anticipated for use.

A more comprehensive flood inundation evaluation is required to ascertain the downstream effects of dam failure.

APPENDIX A

Cost Estimates

- 1. Deer Creek Reservoir, Earthen Dam and Access Roads**
- 2. Deer Creek Reservoir, RCC Dam and Access Roads**

PROJECT: DEER CREEK RESERVOIR, EARTHEN DAM AND ACCESS ROADS
 LOCATION: APPROXIMATELY 14 MILES SOUTH OF WINCHESTER, IDAHO

DISTRICT: WALLA WALLA
 P.O.C.: KIM CALLAN, CHIEF, COST ENGINEERING

CURRENT MCACES ESTIMATE PREPARED: 24 FEB 99
 EFFECTIVE PRICING LEVEL: 1 OCT 99
 COST CNTG CNTG TOTAL
 (\$K) (%) (\$K)

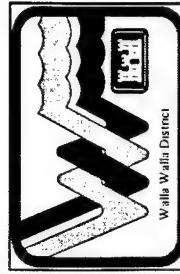
ACCOUNT NUMBER	FEATURE DESCRIPTION	AUTHORIZ./BUDGET YEAR: 1999 EFFECT. PRICING LEVEL: 1 OCT 99	COST (\$K)	CNTG (\$K)	TOTAL (\$K)	SPENT THRU FY 99 (\$K)	COST (\$K)	CNTG (\$K)	FULL (\$K)
03--	RESERVOIRS	114	23	20%	137	117	23	140	126
04--	DAM	3,366	673	20%	4,039	3,454	691	4,145	3,730
08--	ACCESS ROAD	774	155	20%	929	795	159	954	837
	GOVERNMENT FURNISH SERVICES								
	TOTAL CONSTRUCTION COSTS =====:	4,255	851	20%	5,106	4,366	873	5,239	
01--	LANDS AND DAMAGES								
18--	CULTURAL RESOURCES								
21--	RECONNAISSANCE STUDIES								
22--	FEASIBILITY STUDIES								
30--	PLANNING, ENGINEERING & DESIGN	523	103	20%	626	537	105	642	563
31--	CONSTRUCTION MANAGEMENT	29	6	21%	35	29	6	35	32
	TOTAL PROJECT COSTS =====>	4,807	960	20%	5,767	4,932	984	5,916	5,288
	THIS TPCS REFLECTS A PROJECT COST CHANGE OF \$								
	DISTRICT APPROVED DATE: / /								
	CHIEF, COST ENGINEERING, Kim Callan								
	CHIEF, REAL ESTATE, Richard Carlton								
	CHIEF, PLANNING, Dennis Cannon								
	CHIEF, ENGINEERING, Surya Bhamidipaty								
	CHIEF, OPERATIONS, Wayne John								
	CHIEF, CONSTRUCTION, John Treadwell								
	CHIEF, CONTRACTING, Jackie Anderson								
	PROJECT MANAGER, Debbie Willis								
	CHIEF PM-PB, George Veighay								
	DDE (PM), acting David Keller								

.....FULLY FUNDED ESTIMATE.....

TOTAL PROJECT COSTS =====>
 THIS TPCS REFLECTS A PROJECT COST CHANGE OF \$
 DISTRICT APPROVED DATE: / /
 CHIEF, COST ENGINEERING, Kim Callan
 CHIEF, REAL ESTATE, Richard Carlton
 CHIEF, PLANNING, Dennis Cannon
 CHIEF, ENGINEERING, Surya Bhamidipaty
 CHIEF, OPERATIONS, Wayne John
 CHIEF, CONSTRUCTION, John Treadwell
 CHIEF, CONTRACTING, Jackie Anderson
 PROJECT MANAGER, Debbie Willis
 CHIEF PM-PB, George Veighay
 DDE (PM), acting David Keller

DIVISION APPROVED: / /
 DIVISION APPROVED DATE: / /
 CHIEF, COST ENGINEERING, Wally Brassfield
 DIRECTOR, REAL ESTATE, Cynthia Brown
 DIRECTOR OF PROGRAM MANAGEMENT, Mike White
 DIRECTOR OF ENGINEERING & TECHNICAL SERVICES, Jim Crews
 CHIEF, CIVIL PROGRAMS, Clyde Barnhill

TOTAL FEDERAL COSTS =====>
 THE MAXIMUM PROJECT COST IS =====> \$
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NOTE: Valid only when completely signed.





PROJECT: DEER CREEK RESERVOIR, EARTHEN DAM AND ACCESS ROADS  
 LOCATION: APPROXIMATELY 14 MILES SOUTH OF WINCHESTER, IDAHO

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT LETTER, DATED: 24 FEB 99  
 CURRENT MCACES ESTIMATE PREPARED: 24 FEB 99  
 EFFECTIVE PRICING LEVEL: 1 OCT 99

| ACCOUNT NUMBER | FEATURE DESCRIPTION                                                                                                                                                       | COST (\$K) | CNTG (\$K) | TOTAL (\$K) | OMB (%) | COST (\$K) | CNTG (\$K) | TOTAL (\$K) | FEATURE MID PT (%) | OMB (%)  | COST (\$K) | CNTG (\$K) | FULL (\$K) |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------|-------------|---------|------------|------------|-------------|--------------------|----------|------------|------------|------------|
| 08--           | ACCESS ROAD<br>Improve Dirt Access Roads, Approx 14.22 Miles<br>LETTER REPORT dated, May 1999, to evaluated dam alternatives for the Deer Creek Site for Nez Perce Tribe. | 774        | 155        | 20%         | 929     | 2.6%       | 795        | 159         | 954                | 1 QTR 01 | 5.3%       | 837        | 167        |
|                | TOTAL CONSTRUCTION COSTS =====:                                                                                                                                           | 774        | 155        | 20%         | 929     |            | 795        | 159         | 954                |          |            | 837        | 167        |
| 01---          | LANDS AND DAMAGES                                                                                                                                                         |            |            |             |         |            |            |             |                    |          |            |            | 1,004      |

## 02--- LANDS AND DAMAGES

## 22--- FEASIBILITY STUDIES

|       |                                     |    |   |     |    |      |    |   |    |          |      |    |   |
|-------|-------------------------------------|----|---|-----|----|------|----|---|----|----------|------|----|---|
| 30--- | PLANNING, ENGINEERING & DESIGN      | 13 | 2 | 20% | 15 | 2.6% | 13 | 2 | 15 | 1 QTR 00 | 2.6% | 13 | 2 |
| 1.5%  | Project Management                  | 8  | 2 | 20% | 10 | 2.6% | 8  | 2 | 10 | 1 QTR 00 | 2.6% | 8  | 2 |
| 1.0%  | Planning & Environmental Compliance | 40 | 8 | 20% | 48 | 2.6% | 41 | 8 | 49 | 1 QTR 00 | 2.6% | 42 | 8 |
| 5.0%  | Engineering & Design                | 8  | 2 | 20% | 10 | 2.6% | 8  | 2 | 10 | 1 QTR 00 | 2.6% | 8  | 2 |
| 1.0%  | Engineering Tech Review & VE        | 8  | 2 | 20% | 10 | 2.6% | 8  | 2 | 10 | 1 QTR 00 | 2.6% | 8  | 2 |
| 1.0%  | Contracting & Reprographics         | 23 | 5 | 20% | 28 | 2.6% | 24 | 5 | 29 | 1 QTR 01 | 5.3% | 25 | 5 |
| 3.0%  | Engineering During Construction     |    |   |     |    |      |    |   |    |          |      |    |   |
| 31--- | CONSTRUCTION MANAGEMENT             | 9  | 2 | 20% | 11 | 2.6% | 9  | 2 | 11 | 1 QTR 01 | 5.3% | 10 | 2 |
| 8.0%  | Construction Management             | 2  | 2 | 20% | 2  | 2.6% | 2  | 2 | 2  | 1 QTR 01 | 5.3% | 2  | 2 |
| 1.5%  | Project Management                  |    |   |     |    |      |    |   |    |          |      |    |   |

## 30--- CONSTRUCTION MANAGEMENT

|        |                                |     |     |     |       |  |     |     |       |  |  |  |  |
|--------|--------------------------------|-----|-----|-----|-------|--|-----|-----|-------|--|--|--|--|
| 30.2-- | GOVERNMENT FURNISH MATERIALS   | 885 | 178 | 20% | 1,063 |  | 908 | 182 | 1,090 |  |  |  |  |
| 30.2-- | PLANNING, ENGINEERING & DESIGN |     |     |     |       |  |     |     |       |  |  |  |  |

30---  
 15.0% Engineering & Design  
 1.0% Contracting & Reprographics

TOTAL GFS COSTS =====&gt;

----- FULLY FUNDED ESTIMATE.....

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Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. ARMY CORPS OF ENGINEERS  
PROJECT DEERE2: DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE

TIME 14:31:56  
TITLE PAGE 1

DEER CREEK EARTH DAM & ROADS  
Near Winchester, Northern Idaho

PRICE LEVEL 1 Oct 1998

SALES TAX RATE 5.0%, TERO 1.5%

-FOR OFFICIAL USE ONLY--

Designed By: Walla Walla Corp's Engineers  
Estimated By: Karl Pankaskie

Prepared By: Walla Walla Cost Engineer Branch  
Kim Callan, CHIEF, COST ENGR

Preparation Date: 04/16/99

Effective Date of Pricing: 10/01/99

Est Construction Time: 250 Days

Sales Tax: 5.00%

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contained herein is For Official Use Only.

M C A C E S G O L D E D I T I O N  
Composer GOLD Software Copyright (c) 1995-1994  
by Building Systems Design, Inc.  
Release 5.30

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

#### DEER CREEK DAM PROJECT DESCRIPTIONS

##### Main Dam

This option for Deer Creek Dam will be a straight-axis gravity dam structure approximately 600 feet long at the top of the dam. The dam structure will be 80 feet high measured from the deepest point in the foundation. The hydraulic head will be 70 feet measured from the assumed invert elevation of the streambed.

This estimate consists of costs to construct an embankment dam. The embankment dam requires about 5-feet of freeboard for wave action and settlement and an additional 5 to 6-feet for discharge head over the emergency spillway.

The dam center has an impervious core (CH) with a downstream sand filter. In addition to the impervious core, an 80' deep, 5' space, grout curtain will be established beneath the dam to try to reduce leakage beneath the dam. The core is surround with random fill. The upstream outer edges of the random fill are protected with a 12" layer of riprap bedding and then a 30" layer of riprap. The downstream outer edges of the random fill are protected with a 9" layer of gravel bedding and then an 18" layer of cobbles.

##### Spillway

An overflow emergency spillway with a 150-foot crest length is proposed. The spillway will be constructed on the left abutment where a natural saddle would allow for an overland flow of water away from the embankment and back into the Deer Creek downstream of the dam. The spillway features are the approach channel, the formed concrete ogee (including the spillway crest), and the spillway chute.

##### Outlet Works and Impact Basin

The outlet works consists of an intake tower with gates and controls, a 48-inch conduit, and an impact basin energy dissipater.

A low-level intake structure would be constructed upstream of the dam, connected to the outlet conduit pipe for delivering water downstream through the dam and back into Deer Creek through an outlet structure. This inlet concrete box structure will have two slide gates with operators to control the flow of water through the structure.

The outlet conduit pipe will include a concrete embedded 48-inch steel pipe conduit. This pipe will also be used as part of the dewater works.

The impact basin structure would be constructed downstream of the dam and connected to the outlet conduit pipe for delivering water back into the stream. The concrete box structure will have baffles in it to dissipate water energy and to allow proper flow back into the stream.

Conventional concrete will be used for construction of the spillway cap, training walls, conduit encasement, intake structure, impact basin structure, and foundation bedding.

##### Reservoir

The Deer Creek reservoir is approximate 1.5 miles in length. The reservoir basin area at the dam site is approximately 111 acres. Some of the reservoir is forested and will need some preparation for the water that will be backup from the dam.

#### Access Road

Approximately 14.22 miles of access roads will need some improvements. The existing dirt roads shall be leveled, graded, and compacted. Four inches of base material will be placed, graded, and compacted with two inches of gravel top course material placed, graded and compacted on top. This should provide an adequate foundation for the vehicles to access the dam site. A one-lane road with turnouts every 2,000 feet is suggested. Plate - 3 shows the locations of roads needed to be improved and new road sections that will be needed to connect them. New road sections and turnouts should be placed in the field to minimize the amount of environmental damage. As shown on plate 3, some construction roads will need to be 2 lane for construction traffic.

#### BASIS OF DESIGN

This estimate is for letter report dated May 1999 to evaluate dam alternatives for the Deer Creek Site for the Nez Perce Tribe.

#### CONSTRUCTION SCHEDULE

The contractor shall commence work under this contract within 10 calendar days of receiving the notice to proceed; prosecute said work diligently; and complete the entire work ready for use, within the time frame below:

Construction period of the road is unknown at this time.

Construction period of the reservoir is unknown at this time.

Construction period of the dam is unknown at this time.

#### CONSTRUCTION WINDOWS

Construction windows of the all work are unknown at this time.

#### OVERTIME

This estimate contains overtime to complete the project because of the short construction seasons due to high mountain weather.

Overtime was used in the development for the following item costs:

Cherry, drilling, and blasting work

Drilling, and grouting work

High volume earthmoving work

High volume RCC work

The standard contingency of 20% was used for this project.

#### ACQUISITION PLAN

The three low bidding contracts are required as follows 1) constructing the main dam, 2) constructing the roadwork, and 3) clearing the reservoir.

#### SUB-CONTRACTING PLAN

The following are subcontractors on this project:

Crushing and Batching Subcontractor (AH)

Drilling Subcontractor (AG)

Blasting Subcontractor (A1)

Grouting Subcontractor (AK)  
Shotcrete Subcontractor (AL)  
Fencing Subcontractor (AF)  
Guard Rail Subcontractor ()  
Sitework Subcontractor ()

It is assumed that the prime contractor will do the rest of the work.

#### PROJECT CONSTRUCTION

##### SITE ACCESS

Deer Creek Dam site is located on Deer Creek in Lewis County, Idaho and extends across Sections 18, 20, and 28 in T.32N, R.3 W., Boise Meridian. It is located on lands owned by the Nez Perce Tribe in the heart of Nez Perce National Forest. The site is approximately 14 miles south of Winchester, Idaho.

##### BORROW AREAS

The borrow sources for Deer Creek earth embankment dam is as follows:

The impervious core material (CH) will be obtained from excavating the valley floor in the pool area. The CH material will be approximately 5 to 6 feet thick within the first 400 feet of the proposed dam. The clay material will be underlain by clayey sand to clayey gravel approximately 4 to 6 feet thick. Additional clayey gravel can be obtained up the valley to the extent of the investigations.

The random fill material will be obtained from excavating the valley floor.

The sand filter, cobbles or gravel bedding, riprap or cobbles will be available by process crushing (at the same time) materials from the spillway excavation, left abutment quarry or access road quarry. Note: In the quarry site and at a depth of about 15-feet, rocks of 8-to 24-inch size are suitable to be process into riprap or cobbles.

The borrow sources for concrete aggregates will be available by process crushing material from the same sources. Cement can be hauled in and stored on site.

The water source for earth compaction and concrete production will be available from surface water. Upstream of the embankment material sources, a small dike with a culvert will be built. The structure will be constructed to store water for earth compaction and concrete requirements. Groundwater may be viable option; however, no active wells exist in the vicinity of the construction site. The effects of water on properties of concrete should be investigated during production or mix design trials.

#### CONSTRUCTION METHODOLOGY

The construction methodology is standard dam construction.

The site needs to be dewatered because Deer Creek runs through the dam location. A small upstream, earth dike will divert water into a pipe, which becomes a part of the outlet works.

Fri 16 Apr 1999  
EFF. Date 10/01/99  
PROJECT NOTES

U.S. Army Corps of Engineers  
PROJECT DEBRE2 : DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE

TIME 14:31:56  
TITLE PAGE 5

UNUSUAL CONDITIONS (Soil, Water, Weather)  
No unusual conditions occur at the site.

UNIQUE TECHNIQUES OF CONSTRUCTION

No unique technique construction will need to be accomplished.

EQUIPMENT AND LABOR AVAILABILITY & DISTANCE TRAVELED

This estimate uses Davis Bacon labor rates for Lewis County, revision number 11, dated 2/32/99. See the labor spread sheet for development of labor costs used in the estimate.

Equipment rates used are from EP 1110-1-8, Volume 3, September 1997.

ENVIRONMENTAL CONCERNs

This estimate has provisions for Monthly Anticipated Adverse Weather Delays as specified in the contract clauses.

This estimate acknowledges no amendments at this time.

This work will not be performed by a contractor under the Small Business Administration 8a program.

Prices are good for the period May 1999 through October 1999. Total project costs summary spreadsheet will take care of inflation after that.  
><><><><><><><><><><><><><><><><><><><><><><>

Fri 16 Apr 1999  
Eff. Date 10/01/99  
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TIME 14:31:56  
U.S. Army Corps of Engineers  
PROJECT DEERE2: DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE

SUMMARY REPORTS

SUMMARY PAGE

PROJECT INDIRECT SUMMARY - Element.....1  
PROJECT INDIRECT SUMMARY - IND CODE.....3

No Detailed Estimate...

No Backup Reports...

\* \* \* END TABLE OF CONTENTS \* \* \*

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Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERE2 : DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - Element \*\*

TIME 14:31:56  
SUMMARY PAGE 1

|                                   |                               | QUANTITY | UOM | DIRECT   | F-O. Head | Home O&C | Profit  | TERO TAX | BOND    | TOTAL    | UNIT    |
|-----------------------------------|-------------------------------|----------|-----|----------|-----------|----------|---------|----------|---------|----------|---------|
| <hr/>                             |                               |          |     |          |           |          |         |          |         |          |         |
| AC                                | DEER CREEK EARTH DAM & ROADS  |          |     |          |           |          |         |          |         |          |         |
| AC-03                             | RESERVOIRS                    |          |     |          |           |          |         |          |         |          |         |
| AC-03.1                           | RESERVOIRS                    |          |     |          |           |          |         |          |         |          |         |
| AC-03.1.3                         | CLEARING AND DEBRIS REMOVAL   | 111.00   | ACR | 87,549   | 8,755     | 6,741    | 7,213   | 1,654    | 2,238   | 114,151  | 1028.39 |
| TOTAL RESERVOIRS                  |                               | 111.00   | ACR | 87,549   | 8,755     | 6,741    | 7,213   | 1,654    | 2,238   | 114,151  | 1028.39 |
| TOTAL RESERVOIRS                  |                               | 111.00   | ACR | 87,549   | 8,755     | 6,741    | 7,213   | 1,654    | 2,238   | 114,151  | 1028.39 |
| AC-04                             | DAMS (COMPACTED EARTH FILL)   |          |     |          |           |          |         |          |         |          |         |
| AC-04.1                           | MAIN DAM                      |          |     |          |           |          |         |          |         |          |         |
| AC-04.1.A                         | MOB., DEMOB., AND PREWORK     | 127.625  |     | 19,144   | 5,871     | 10,685   | 2,450   | 3,315    | 169,090 |          |         |
| AC-04.1.C                         | SITE ACCESS ROADS & PARKING   | 110,459  |     | 16,569   | 5,091     | 9,248    | 2,120   | 2,870    | 146,347 |          |         |
| AC-04.1.D                         | EARTHWORK FOR STRUCTURES      | 33,501   |     | 5,025    | 1,551     | 2,805    | 643     | 870      | 44,385  |          |         |
| AC-04.1.E                         | FOUNDATION WORK               | 20,000   | SF  | 263,617  | 39,543    | 12,126   | 22,070  | 5,060    | 6,848   | 349,264  | 17.46   |
| AC-04.1.S                         | COMPACTED EARTH DAM           | 214,000  | CY  | 144,9560 | 216,444   | 66,376   | 120,805 | 27,699   | 37,486  | 191,1770 | 8.93    |
| TOTAL MAIN DAM                    |                               | 214,000  | CY  | 197,8162 | 296,724   | 90,995   | 165,612 | 37,972   | 51,389  | 262,0856 | 12.25   |
| AC-04.2                           | SPILLWAY                      |          |     |          |           |          |         |          |         |          |         |
| AC-04.2.9                         | EARTHWORK FOR STRUCTURES      | 155,144  |     | 23,272   | 7,137     | 12,989   | 2,978   | 4,030    | 205,550 |          |         |
| AC-04.2.A                         | FOUNDATION WORK               | 2,162    |     | 324      | 99        | 181      | 41      | 56       | 2,864   |          |         |
| AC-04.2.F                         | CONCRETE OVERFLOW SECTION     | 90,500   |     | 13,575   | 4,163     | 7,577    | 1,737   | 2,351    | 119,903 |          |         |
| TOTAL SPILLWAY                    |                               | 1.00     | EA  | 247,806  | 37,171    | 11,399   | 20,746  | 4,757    | 6,438   | 328,316  | 328316  |
| AC-04.3                           | OUTLET WORKS                  |          |     |          |           |          |         |          |         |          |         |
| AC-04.3.1                         | APPROACH AND OUTLET CHANNELS  | 1.00     | EA  | 20,526   | 3,079     | 944      | 1,718   | 394      | 533     | 27,195   | 271.95  |
| AC-04.3.3                         | CONDUIT OR TUNNEL             | 440.00   | LF  | 147,991  | 22,199    | 6,908    | 12,390  | 2,841    | 3,845   | 196,072  | 445.62  |
| AC-04.3.4                         | INTAKE STRUCTURE              | 45.00    | VLF | 146,221  | 21,933    | 6,726    | 12,242  | 2,807    | 3,799   | 193,727  | 4305.05 |
| TOTAL OUTLET WORKS                |                               | 92.00    | LF  | 314,738  | 47,211    | 14,478   | 26,350  | 6,042    | 8,176   | 416,994  | 4532.54 |
| TOTAL DAMS (COMPACTED EARTH FILL) |                               | 214,000  | CY  | 254,0706 | 381,106   | 116,872  | 212,708 | 48,771   | 66,003  | 3366166  | 15.73   |
| AC-08                             | ROADS, RAILROADS, AND BRIDGES |          |     |          |           |          |         |          |         |          |         |
| AC-08.1                           | ROADS                         |          |     |          |           |          |         |          |         |          |         |

LABOR ID: NIDAA9 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

PROJECT DEERE2 : DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - Element \*\*

TIME 14:31:56

SUMMARY PAGE 2

|           |                                     | QUANTITY | UOM | DIRECT  | F-O. Head | Home OFC | Profit | TERO TAX | BOND    | TOTAL   | UNIT  |
|-----------|-------------------------------------|----------|-----|---------|-----------|----------|--------|----------|---------|---------|-------|
| AC-08.1.B | FOREST ROAD, IMPROVE EXISTING(A)    | 36600    | LF  | 456,943 | 68,541    | 33,286   | 39,114 | 8,968    | 12,137  | 618,889 | 16.91 |
| AC-08.1.C | NEW PERM SITE ACCESS ROADS (B)      | 1050.00  | LF  | 56,383  | 8,457     | 4,438    | 4,849  | 1,112    | 1,505   | 76,744  | 73.09 |
| AC-08.1.D | NEW PERM-TO-TOP OF DAM A-ROAD (C)   | 1735.00  | LF  | 57,403  | 8,610     | 4,460    | 4,933  | 1,131    | 1,531   | 78,068  | 45.00 |
|           |                                     |          |     |         |           |          |        |          |         |         |       |
|           | TOTAL ROADS                         | 45301    | LF  | 570,728 | 85,609    | 42,184   | 48,897 | 11,211   | 15,173  | 773,802 | 17.08 |
|           |                                     |          |     |         |           |          |        |          |         |         |       |
|           | TOTAL ROADS, RAILROADS, AND BRIDGES | 8.58     | MI  | 570,728 | 85,609    | 42,184   | 48,897 | 11,211   | 15,173  | 773,802 | 90190 |
|           |                                     |          |     |         |           |          |        |          |         |         |       |
|           | TOTAL DEER CREEK EARTH DAM & ROADS  | 3198983  |     | 475,470 | 165,798   | 268,818  | 61,636 | 83,414   | 4254119 |         |       |

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

ri 16 Apr 1999  
ff. Date 10/01/99

U.S. Army Corps of Engineers  
DEER GREEK EARTH DAM & ROADS - NEAR W.  
EARTH DAM FOR DEER CREEK, BUDGET EST.  
\*\* PROJECT DIRECTOR'S SUMMARY - TND CO.

**U.S. Army Corps of Engineers**  
**DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho**  
**EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE**  
**\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\***

TIME 14:31:56  
SUMMARY PAGE 3

-----  
QUANTY UCM DIRECT F-O,Head Home OFC Profit TERO TAX BOND TOTAL UNIT

AC DEEP CREEK EARTH DAM & BOARDS

AC-03 REPROVATICS

AC-03 - 1 RESEVOIRS

### **AC-03.1.3 CLEARING AND DEBRIS REMOVAL**

AC-03.1.3-01 - CLEARING AND DEBRIS REMOVAL

AC-03.1.3-01--02AB Clear, Grubb, Hwy Brush

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THE JOURNAL OF CLIMATE

|        |       |       |       |     |       |        |
|--------|-------|-------|-------|-----|-------|--------|
| 48,192 | 7,229 | 2,217 | 4,035 | 925 | 1,252 | 63,850 |
| 17,518 | 2,628 | 805   | 1,467 | 336 | 455   | 23,209 |

*Estimated*      *Actual*      *Estimated*      *Actual*

|          |        |       |       |       |     |     |        |         |
|----------|--------|-------|-------|-------|-----|-----|--------|---------|
| 2.00 TRP | 1,906  | 286   | 88    | 160   | 37  | 50  | 2,525  | 1262.46 |
|          | 25,850 | 3,877 | 1,189 | 2,164 | 496 | 672 | 34,248 |         |

AC-04-1 A-02- DIVERSTION AND CARE OF WATER

|           |         |    |       |     |     |     |    |     |       |        |
|-----------|---------|----|-------|-----|-----|-----|----|-----|-------|--------|
| Dia CMP   | 50.00   | UF | 4,498 | 675 | 207 | 377 | 86 | 117 | 5,959 | 119.18 |
| r Dike    | 1800.00 | CX | 1,074 | 161 | 49  | 90  | 21 | 28  | 1,423 | 0.79   |
| Inlet Str | 1.00    | EA | 0     | 0   | 0   | 0   | 0  | 0   | 0     | 0.01   |
| Dia CMP   | 50.00   | LF | 758   | 114 | 35  | 63  | 15 | 20  | 1,004 | 20.08  |

Fri 16 Apr 1999  
Eff. Date 10/01/99

## U.S. Army Corps of Engineers

PROJECT DEERE2: DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 4

|                                                  | QUANTITY | UOM | DIRECT | F.O. Head | Home OFC | Profit | TERO TAX | BOND    | TOTAL  | UNIT    |
|--------------------------------------------------|----------|-----|--------|-----------|----------|--------|----------|---------|--------|---------|
| TOTAL DIVERSION AND CARE OF WATER                | 240.00   | LF  | 8,774  | 1,316     | 404      | 735    | 168      | 228     | 11,624 | 48.44   |
| AC-04.1.A-03 - STORAGE & PONDING OF CONSTR WATER |          |     |        |           |          |        |          |         |        |         |
| AC-04.1.A-03--02AA Diversion Conduit 48" Dia CMP | 20.00    | LF  | 1,732  | 260       | 80       | 145    | 33       | 45      | 2,294  | 114.72  |
| AC-04.1.A-03--02BA Diversion Conduit Upper Dike  | 1800.00  | CY  | 1,601  | 240       | 74       | 134    | 31       | 42      | 2,122  | 1.18    |
| AC-04.1.A-03--02CA Remove D Conduit 48" Dia CMP  | 20.00    | LF  | 303    | 45        | 14       | 25     | 6        | 8       | 402    | 20.08   |
| AC-04.1.A-03--02LA Remove Diversion Upper Dike   | 1800.00  | CY  | 2,315  | 347       | 106      | 194    | 44       | 60      | 3,067  | 1.70    |
| TOTAL STORAGE & PONDING OF CONSTR WATER          | 1.00     | EA  | 5,951  | 893       | 274      | 498    | 114      | 155     | 7,885  | 7885.02 |
| TOTAL MOB., DEMOB., AND PREWORK                  | 127.625  |     | 19,144 | 5,871     | 10,685   | 2,450  | 3,315    | 169,090 |        |         |

## AC-04.1.C SITE ACCESS ROADS &amp; PARKING

## AC-04.1.C-03- SITE FENCING

|                                          |        |    |        |       |     |       |     |     |        |         |
|------------------------------------------|--------|----|--------|-------|-----|-------|-----|-----|--------|---------|
| AC-04.1.C-03--02BA 6' Site Fencing       | 630.00 | LF | 14,964 | 2,245 | 688 | 1,253 | 287 | 389 | 19,826 | 31.47   |
| AC-04.1.C-03--02BC 6' Site Fencing Gates | 3.00   | EA | 3,761  | 564   | 173 | 315   | 72  | 98  | 4,983  | 1660.92 |
| TOTAL SITE FENCING                       | 630.00 | LF | 18,725 | 2,809 | 861 | 1,568 | 359 | 486 | 24,809 | 39.38   |

## AC-04.1.C-04- DECK GUARD RAIL

|                                                      |         |    |        |       |       |       |       |       |        |        |
|------------------------------------------------------|---------|----|--------|-------|-------|-------|-------|-------|--------|--------|
| AC-04.1.C-04--02AA Guardrail,S-Rail, Wood Posts      | 1300.00 | LF | 58,740 | 8,811 | 2,702 | 4,918 | 1,128 | 1,526 | 77,824 | 59.86  |
| AC-04.1.C-04--02AB Guardrail,S-Rail, Wood Post, Ends | 8.00    | EA | 1,482  | 222   | 68    | 124   | 28    | 38    | 1,963  | 245.36 |
| TOTAL DECK GUARD RAIL                                | 1300.00 | LF | 60,222 | 9,033 | 2,770 | 5,042 | 1,156 | 1,564 | 79,787 | 61.37  |

## AC-04.1.C-05- DRYLAND GRASS ESTABLISHMENT

## AC-04.1.C-05--02BA Dryland Grass Establishment

## TOTAL DRYLAND GRASS ESTABLISHMENT

|                                                |       |    |       |     |    |     |    |    |       |        |
|------------------------------------------------|-------|----|-------|-----|----|-----|----|----|-------|--------|
| AC-04.1.C-06- CULVERTS - 18 INCH (1 EACH)      |       |    |       |     |    |     |    |    |       |        |
| AC-04.1.C-06--02AA Culverts - Excavation       | 7.00  | CY | 192   | 29  | 9  | 16  | 4  | 5  | 255   | 36.42  |
| AC-04.1.C-06--02BA Culverts - 18 Inch CMP      | 20.00 | LF | 460   | 69  | 21 | 39  | 9  | 12 | 610   | 30.50  |
| AC-04.1.C-06--02CA Culverts - Backfill Bedding | 5.00  | CY | 539   | 81  | 25 | 45  | 10 | 14 | 715   | 142.95 |
| TOTAL CULVERTS - 18 INCH (1 EACH)              | 20.00 | LF | 1,192 | 179 | 55 | 100 | 23 | 31 | 1,580 | 78.98  |

## AC-04.1.C-11- TRIANGULATION SURVEY

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA



Fri 16 Apr 1999  
Eff. Date 10/01/99

## U.S. Army Corps of Engineers

PROJECT DEERE2 : DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 6

|                                                      | QUANTITY            | UOM        | DIRECT        | F-O. Head     | Home OEC     | Profit       | TERO TAX     | BOND         | TOTAL         | UNIT          |
|------------------------------------------------------|---------------------|------------|---------------|---------------|--------------|--------------|--------------|--------------|---------------|---------------|
| <b>AC-04.1.D EARTHWORK FOR STRUCTURES</b>            |                     |            |               |               |              |              |              |              |               |               |
| <b>AC-04.1.D-12A EXCAVATION,UNCLASF</b>              |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.D-12A-02AA Excavation and Strip Foundation   | 1945.00             | SY         | 10,238        | 1,536         | 471          | 857          | 197          | 266          | 13,564        | 6.97          |
| AC-04.1.D-12A-02BA Excavation and Haul Common        | 5200.00             | BCY        | 13,297        | 1,995         | 612          | 1,113        | 255          | 345          | 17,617        | 3.39          |
| AC-04.1.D-12A-02BC Rip Rock                          | 300.00              | BCY        | 1,419         | 213           | 65           | 119          | 27           | 37           | 1,880         | 6.27          |
| AC-04.1.D-12A-02BD Blast Boulders                    | 18.00               | BCY        | 1,020         | 153           | 47           | 85           | 20           | 27           | 1,352         | 75.11         |
| AC-04.1.D-12A-02BE Load & Haul Ripped & Blasted Rock | 300.00              | BCY        | 819           | 123           | 38           | 69           | 16           | 21           | 1,084         | 3.61          |
| AC-04.1.D-12A-02BF Maintain Haul Roads               | 5500.00             | BCY        | 6,707         | 1,006         | 309          | 562          | 129          | 174          | 8,886         | 1.62          |
| <b>TOTAL EXCAVATION,UNCLASF</b>                      | <b>5500.00</b>      | <b>CY</b>  | <b>33,501</b> | <b>5,025</b>  | <b>1,541</b> | <b>2,805</b> | <b>643</b>   | <b>870</b>   | <b>44,385</b> | <b>8.07</b>   |
| <b>TOTAL EARTHWORK FOR STRUCTURES</b>                | <b>6400.00</b>      | <b>CY</b>  | <b>33,501</b> | <b>5,025</b>  | <b>1,541</b> | <b>2,805</b> | <b>643</b>   | <b>870</b>   | <b>44,385</b> | <b>6.94</b>   |
| <b>AC-04.1.E FOUNDATION WORK</b>                     |                     |            |               |               |              |              |              |              |               |               |
| <b>AC-04.1.E-16A EXPLORATORY DRILLING</b>            |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.E-16A-02BA NX Exploratory Drilling           | 200.00              | LF         | 17,938        | 2,691         | 825          | 1,502        | 344          | 466          | 23,766        | 118.83        |
| <b>TOTAL EXPLORATORY DRILLING</b>                    | <b>200.00</b>       | <b>LF</b>  | <b>17,938</b> | <b>2,691</b>  | <b>825</b>   | <b>1,502</b> | <b>344</b>   | <b>466</b>   | <b>23,766</b> | <b>118.83</b> |
| <b>AC-04.1.E-17A PRESSURE TESTING NX HOLE</b>        |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.E-17A-02BA Pressure Testing NX Hole          | 200.00              | MIN        | 1,600         | 240           | 74           | 134          | 31           | 42           | 2,120         | 10.60         |
| <b>TOTAL PRESSURE TESTING NX HOLE</b>                | <b>200.00</b>       | <b>MIN</b> | <b>1,600</b>  | <b>240</b>    | <b>74</b>    | <b>134</b>   | <b>31</b>    | <b>42</b>    | <b>2,120</b>  | <b>10.60</b>  |
| <b>AC-04.1.E-19A FOUNDATION CLEANUP</b>              |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.E-19A-02BA Foundation Cleanup                | 4240.00             | SY         | 55,055        | 8,258         | 2,533        | 4,609        | 1,057        | 1,430        | 72,942        | 17.20         |
| <b>TOTAL FOUNDATION CLEANUP</b>                      | <b>4240.00</b>      | <b>SY</b>  | <b>55,055</b> | <b>8,258</b>  | <b>2,533</b> | <b>4,609</b> | <b>1,057</b> | <b>1,430</b> | <b>72,942</b> | <b>17.20</b>  |
| <b>AC-04.1.E-22A FOUND.TREAT.DRILL GROUT CURTAIN</b> |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.E-22A-02BA Drill Foundation Grout Curtain    | 6400.00             | LF         | 73,035        | 10,955        | 3,360        | 6,114        | 1,402        | 1,897        | 96,763        | 15.12         |
| <b>TOTAL FOUND.TREAT.DRILL GROUT CURTAIN</b>         | <b>6400.00</b>      | <b>LF</b>  | <b>73,035</b> | <b>10,955</b> | <b>3,360</b> | <b>6,114</b> | <b>1,402</b> | <b>1,897</b> | <b>96,763</b> | <b>15.12</b>  |
| <b>AC-04.1.E-23A FOUND.TREAT.DRILL HOLE SETUPS</b>   |                     |            |               |               |              |              |              |              |               |               |
| AC-04.1.E-23A-03AA Grout Holes Setups                | 240.00              | EA         | 23,810        | 3,571         | 1,095        | 1,993        | 457          | 619          | 31,546        | 131.44        |
| <b>TOTAL FOUND.TREAT.DRILL HOLE SETUPS</b>           | <b>240.00</b>       | <b>EA</b>  | <b>23,810</b> | <b>3,571</b>  | <b>1,095</b> | <b>1,993</b> | <b>457</b>   | <b>619</b>   | <b>31,546</b> | <b>131.44</b> |
| LABOR ID: NIDA99 EQUIP ID: NAT97A                    | Currency in DOLLARS |            |               |               |              |              |              |              |               |               |



Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERE: DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 8

|                                        | QUANTITY                         | UOM     | DIRECT | F.O. Head | Home  | OFC   | Profit | TERO TAX | BOND   | TOTAL  | UNIT |
|----------------------------------------|----------------------------------|---------|--------|-----------|-------|-------|--------|----------|--------|--------|------|
| AC-04.1.S-26--02AC                     | Crushing & Stockpile Materials   | 5576.00 | LCY    | 27,244    | 4,087 | 1,253 | 2,281  | 523      | 708    | 36,096 | 6.47 |
| AC-04.1.S-26--02BA                     | Load,Haul & Dumping Cobble Rocks | 4130.00 | BCY    | 17,716    | 2,657 | 815   | 1,483  | 340      | 460    | 23,472 | 5.68 |
| AC-04.1.S-26--02CA                     | Placing and Keying in Cobbles    | 4130.00 | BCY    | 6,048     | 907   | 278   | 506    | 116      | 157    | 8,013  | 1.94 |
| TOTAL COBBLE 18"THICK SLOPE PROTECTION | 4130.00 CY                       | 51,008  |        | 7,651     | 2,346 | 4,270 | 979    | 1,325    | 67,581 | 16.36  |      |

AC-04.1.S-27- RIPRAP BEDDING, (12"THICK GRAVEL)

|                                         | QUANTITY                         | UOM     | DIRECT | F.O. Head | Home  | OFC   | Profit | TERO TAX | BOND   | TOTAL  | UNIT |
|-----------------------------------------|----------------------------------|---------|--------|-----------|-------|-------|--------|----------|--------|--------|------|
| AC-04.1.S-27--02AC                      | Crushing & Stockpile Materials   | 4752.00 | LCY    | 23,218    | 3,483 | 1,068 | 1,944  | 446      | 603    | 30,762 | 6.47 |
| AC-04.1.S-27--02BA                      | Load,Haul & Place Riprap Bedding | 3120.00 | BCY    | 15,058    | 2,259 | 693   | 1,261  | 289      | 391    | 19,951 | 5.77 |
| TOTAL RIPRAP BEDDING, (12"THICK GRAVEL) | 3520.00 CY                       | 38,276  |        | 5,741     | 1,761 | 3,205 | 735    | 994      | 50,712 | 14.41  |      |

AC-04.1.S-28- RIPRAP 30"THICK SLOPE PROTECTION

|                                        | QUANTITY                       | UOM     | DIRECT | F.O. Head | Home   | OFC     | Profit | TERO TAX | BOND    | TOTAL   | UNIT  |
|----------------------------------------|--------------------------------|---------|--------|-----------|--------|---------|--------|----------|---------|---------|-------|
| AC-04.1.S-28--02AC                     | Crushing & Stockpile Materials | 18040   | LCY    | 88,143    | 13,221 | 4,055   | 7,379  | 1,692    | 2,290   | 116,780 | 6.47  |
| AC-04.1.S-28--02BA                     | Load, Haul & Dumping Riprap    | 9020.00 | BCY    | 82,379    | 12,357 | 3,789   | 6,897  | 1,581    | 2,140   | 109,143 | 12.10 |
| AC-04.1.S-28--02CA                     | Placing and Keying in Riprap   | 9020.00 | BCY    | 14,257    | 2,138  | 656     | 1,194  | 274      | 370     | 18,888  | 2.09  |
| TOTAL RIPRAP 30"THICK SLOPE PROTECTION | 9020.00 CY                     | 184,778 |        | 27,717    | 8,500  | 15,470  | 3,547  | 4,800    | 244,812 | 27.14   |       |
| TOTAL COMPACTED EARTH DAM              | 214000 CY                      | 1442960 |        | 216,444   | 66,376 | 120,805 | 27,699 | -        | 37,486  | 1911770 | 8.93  |
| TOTAL MAIN DAM                         | 214000 CY                      | 1978162 |        | 236,724   | 90,995 | 165,612 | 37,972 | 51,389   | 2620856 | 12.25   |       |

AC-04.2 SPILLWAY

AC-04.2.9 EARTHWORK FOR STRUCTURES

AC-04.2.9-11A EXCAVATION,UNCLAS

|                          | QUANTITY                          | UOM     | DIRECT | F.O. Head | Home  | OFC   | Profit | TERO TAX | BOND   | TOTAL  | UNIT  |
|--------------------------|-----------------------------------|---------|--------|-----------|-------|-------|--------|----------|--------|--------|-------|
| AC-04.2.9-11A-02AA       | Excavation and Strip Foundation   | 5220.00 | SY     | 27,477    | 4,122 | 1,264 | 2,300  | 527      | 714    | 36,404 | 6.97  |
| AC-04.2.9-11A-02BA       | Excavation and Strip Common       | 5080.00 | BCY    | 15,588    | 2,338 | 717   | 1,305  | 299      | 405    | 20,653 | 4.07  |
| AC-04.2.9-11A-02BB       | Excavation and Trim Common        | 1000.00 | BCY    | 1,540     | 231   | 71    | 129    | 30       | 40     | 2,040  | 2.04  |
| AC-04.2.9-11A-02BC       | Rip Rock                          | 300.00  | BCY    | 1,419     | 213 * | 65    | 119    | 27       | 37     | 1,880  | 6.27  |
| AC-04.2.9-11A-02BD       | Blast Boulders                    | 12.00   | BCY    | 680       | 102   | 31    | 57     | 13       | 18     | 901    | 75.11 |
| AC-04.2.9-11A-02BE       | Load & Haul Ripped & Blasted Rock | 300.00  | BCY    | 819       | 123   | 38    | 69     | 16       | 21     | 1,084  | 3.61  |
| TOTAL EXCAVATION,UNCLASF | 3700.00 CY                        | 47,523  |        | 7,128     | 2,186 | 3,379 | 912    | 1,235    | 62,963 | 17.02  |       |

AC-04.2.9-12A EXCAVATION, ROCK EXCAVATION

|                    | QUANTITY                          | UOM     | DIRECT | F.O. Head | Home  | OFC   | Profit | TERO TAX | BOND  | TOTAL  | UNIT  |
|--------------------|-----------------------------------|---------|--------|-----------|-------|-------|--------|----------|-------|--------|-------|
| AC-04.2.9-12A-02BA | Rock, Drill, Shot & Producing     | 9120.00 | CY     | 50,692    | 7,604 | 2,332 | 4,244  | 973      | 1,317 | 67,162 | 7.36  |
| AC-04.2.9-12A-02BC | Prosplit Rock, Drill, & Shot      | 1400.00 | Lf     | 30,591    | 4,589 | 1,407 | 2,561  | 587      | 795   | 40,529 | 28.95 |
| AC-04.2.9-12A-02BE | Load & Haul Ripped & Blasted Rock | 9120.00 | BCY    | 26,338    | 3,951 | 1,212 | 2,205  | 566      | 684   | 34,895 | 3.83  |

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERE2: DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 9

|                                   | QUANTITY | uom | DIRECT  | F.O. Head | Home   | OFC   | Profit | TERO TAX | BOND    | TOTAL   | UNIT |
|-----------------------------------|----------|-----|---------|-----------|--------|-------|--------|----------|---------|---------|------|
| <hr/>                             |          |     |         |           |        |       |        |          |         |         |      |
| TOTAL EXCAVATION, ROCK EXCAVATION | 9120.00  | CY  | 107,621 | 16,143    | 4,951  | 9,010 | 2,066  | 2,796    | 142,587 | 15,63   |      |
| TOTAL EARTHWORK FOR STRUCTURES    | 155,144  |     | 23,272  | 7,137     | 12,989 | 2,978 |        |          | 4,030   | 205,550 |      |

AC-04.2.A FOUNDATION WORK

AC-04.2.A-19A FOUNDATION CLEANUP

|                                       |        |    |       |     |     |     |    |       |       |       |
|---------------------------------------|--------|----|-------|-----|-----|-----|----|-------|-------|-------|
| AC-04.2.A-19A-02BA Foundation Cleanup | 150.00 | SY | 2,162 | 324 | 99  | 181 | 41 | 56    | 2,864 | 19.09 |
| TOTAL FOUNDATION CLEANUP              | 150.00 |    |       |     |     |     |    |       |       |       |
| TOTAL FOUNDATION WORK                 | 2,162  |    | 324   | 99  | 181 | 41  | 56 | 2,864 |       |       |

AC-04.2.F CONCRETE OVERFLOW SECTION

AC-04.2.F-20- CONCRETE OVERFLOW SECTION

|                                                   |        |    |         |        |        |        |       |       |         |        |
|---------------------------------------------------|--------|----|---------|--------|--------|--------|-------|-------|---------|--------|
| AC-04.2.F-20--03CA Concrete Overflow Section      | 245.00 | CY | 45,711  | 6,857  | 2,103  | 3,827  | 877   | 1,187 | 60,562  | 247.19 |
| AC-04.2.F-20--03DA Concrete Retaining Walls Slabs | 33.00  | CY | 10,180  | 1,527  | 468    | 852    | 195   | 264   | 13,488  | 408.72 |
| AC-04.2.F-20--03DD Concrete Retaining Walls       | 34.609 |    | 5,191   | 1,592  | 2,897  | 664    | 664   | 859   | 45,853  | 458.53 |
| TOTAL CONCRETE OVERFLOW SECTION                   | 355.00 | CY | 90,500  | 13,575 | 4,163  | 7,577  | 1,737 | 2,351 | 119,903 | 337.75 |
| TOTAL CONCRETE OVERFLOW SECTION                   | 90,500 |    | 13,575  | 4,163  | 7,577  | 1,737  |       |       |         |        |
| TOTAL SPILLWAY                                    | 1.00   | EA | 247,806 | 37,171 | 11,399 | 20,746 | 4,757 | 6,438 | 328,316 | 328316 |

AC-04.3 OUTLET WORKS

AC-04.3.1 APPROACH AND OUTLET CHANNELS

AC-04.3.1-35- CONCRETE OUTLET&IMPACT BASIN STR

|                                                      |        |     |        |       |     |       |     |     |        |        |
|------------------------------------------------------|--------|-----|--------|-------|-----|-------|-----|-----|--------|--------|
| AC-04.3.1-35--02BG Outlet Channel Rip Rap, 20" Thick | 100.00 | ECY | 9,155  | 1,373 | 421 | 766   | 176 | 238 | 12,130 | 121.30 |
| AC-04.3.1-35--03CC Concr. Impact Basin Slab          | 5.00   | CY  | 1,591  | 239   | 73  | 133   | 31  | 41  | 2,108  | 421.56 |
| AC-04.3.1-35--03CD Concr. Impact Basin Wall & Baffle | 15.00  | CY  | 8,837  | 1,326 | 407 | 740   | 170 | 230 | 11,708 | 780.56 |
| AC-04.3.1-35--03CE Concr. Impact Basin Precast Slab  | 2.00   | CY  | 942    | 141   | 43  | 79    | 18  | 24  | 1,249  | 624.29 |
| TOTAL CONCRETE OUTLET&IMPACT BASIN STR               | 1.00   | EA  | 20,526 | 3,079 | 944 | 1,718 | 394 | 533 | 27,195 | 27195  |
| TOTAL APPROACH AND OUTLET CHANNELS                   | 1.00   | EA  | 20,526 | 3,079 | 944 | 1,718 | 394 | 533 | 27,195 | 27195  |

AC-04.3.3 CONDUIT OR TUNNEL

AC-04.3.3-33- OUTLET CONDUIT ( 48" DIA. PIPE )

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERE2 : DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 10

|                                        |                                  | QUANTY | UOM | DIRECT  | F-O,Head | Home OFC | Profit | TERO TAX | BOND  | TOTAL   | UNIT   |
|----------------------------------------|----------------------------------|--------|-----|---------|----------|----------|--------|----------|-------|---------|--------|
| AC-04.3.3-02QA                         | Outlet Conduit ( 48" Dia. Pipe ) | 440.00 | LF  | 81,022  | 12,153   | 3,727    | 6,783  | 1,555    | 2,105 | 107,345 | 243.97 |
| TOTAL OUTLET CONDUIT ( 48" DIA. PIPE ) |                                  | 440.00 | LF  | 81,022  | 12,153   | 3,727    | 6,783  | 1,555    | 2,105 | 107,345 | 243.97 |
|                                        |                                  |        |     |         |          |          |        |          |       |         |        |
| AC-04.3.3-34A                          | OUTLET CONDUIT CONCRETE          | 396.00 | CY  | 66,969  | 10,045   | 3,081    | 5,607  | 1,286    | 1,740 | 88,727  | 224.06 |
| AC-04.3.3-03CA                         | Outlet Conduit Concrete          | 396.00 | CY  | 66,969  | 10,045   | 3,081    | 5,607  | 1,286    | 1,740 | 88,727  | 224.06 |
| TOTAL OUTLET CONDUIT CONCRETE          |                                  | 396.00 | CY  | 66,969  | 10,045   | 3,081    | 5,607  | 1,286    | 1,740 | 88,727  | 224.06 |
| TOTAL CONDUIT OR TUNNEL                |                                  | 440.00 | LF  | 147,991 | 22,199   | 6,806    | 12,390 | 2,841    | 3,845 | 196,072 | 445.62 |
|                                        |                                  |        |     |         |          |          |        |          |       |         |        |

AC-04.3.4 INTAKE STRUCTURE

AC-04.3.4-32- INTAKE STRUCTURE

|                                   |                                   |         |     |          |         |         |         |        |        |         |         |
|-----------------------------------|-----------------------------------|---------|-----|----------|---------|---------|---------|--------|--------|---------|---------|
| AC-04.3.4-32--02CA                | Intake Tower Foundation Slab      | 16.00   | CY  | 3,357    | 504     | 154     | 281     | 64     | 87     | 4,447   | 277.96  |
| AC-04.3.4-32--03CB                | Intake Tower Walls                | 15.00   | CY  | 9,659    | 1,449   | 444     | 809     | 185    | 251    | 12,798  | 853.18  |
| AC-04.3.4-32--03CC                | Intake Tower Elevated Slab        | 2.00    | CY  | 1,801    | 270     | 83      | 151     | 35     | 2,386  | 1193.07 |         |
| AC-04.3.4-32--03CD                | Intake Gate Controller Slab       | 50.00   | CY  | 12,485   | 1,873   | 574     | 1,045   | 240    | 324    | 16,541  | 330.83  |
| AC-04.3.4-32--03AB                | Intake Tower Control Room         | 200.00  | SF  | 4,000    | 600     | 184     | 335     | 77     | 104    | 5,300   | 26.50   |
| AC-04.3.4-32--05EB                | Intake Tower Trashracks           | 1770.00 | LB  | 6,698    | 1,005   | 308     | 561     | 129    | 174    | 8,875   | 5.01    |
| AC-04.3.4-32--15QA                | 24" x 24" Slide Gate & Controller | 2.00    | EA  | 105,806  | 15,871  | 4,867   | 8,858   | 2,031  | 2,749  | 140,182 | 70091   |
| AC-04.3.4-32--15QB                | 12" Dia. Vent Pipe                | 220.00  | LF  | 2,114    | 362     | 111     | 202     | 46     | 63     | 3,199   | 14.54   |
| TOTAL INTAKE STRUCTURE            |                                   | 45.00   | VLF | 146,221  | 21,933  | 6,726   | 12,242  | 2,807  | 3,799  | 193,727 | 4305.05 |
| TOTAL INTAKE STRUCTURE            |                                   | 45.00   | VLF | 146,221  | 21,933  | 6,726   | 12,242  | 2,807  | 3,799  | 193,727 | 4305.05 |
| TOTAL OUTLET WORKS                |                                   | 92.00   | LF  | 314,738  | 47,211  | 14,478  | 26,350  | 6,042  | 8,176  | 416,994 | 4532.54 |
| TOTAL DAMS (COMPACTED EARTH FILL) |                                   | 214,000 | CY  | 254,0706 | 381,106 | 116,872 | 212,708 | 48,771 | 66,003 | 3366166 | 15.73   |
|                                   |                                   |         |     |          |         |         |         |        |        |         |         |

AC-08 ROADS, RAILROADS, AND BRIDGES

AC-08.1 ROADS

AC-08.1.B FOREST ROAD, IMPROVE EXISTING (A)

AC-08.1.B-02- FOREST ROAD, CRUSHD SURFACING MAT

|                                        |                                 |         |     |        |       |       |       |       |         |        |      |
|----------------------------------------|---------------------------------|---------|-----|--------|-------|-------|-------|-------|---------|--------|------|
| AC-08.1.B-02--02BA                     | Produce Surface Materials Dr&BL | 1,2750  | BCY | 45,911 | 6,887 | 2,112 | 3,844 | 681   | 1,193   | 60,827 | 4.77 |
| AC-08.1.B-02--02BB                     | Crushing & Stockpile Materials  | 11,475  | LCY | 55,486 | 8,323 | 2,552 | 4,145 | 1,065 | 1,441   | 73,513 | 6.41 |
| TOTAL FOREST ROAD,CRUSHD SURFACING MAT | 8500.00 CY                      | 101,397 |     | 15,210 | 4,664 | 8,489 | 1,946 | 2,634 | 134,340 | 15.80  |      |
| AC-08.1.B-03-                          | FOREST ROAD, PREP FOR SURFACING |         |     |        |       |       |       |       |         |        |      |

LABOR ID: NIDA99 EQUIP ID: NAT97A

AC-08.1.B-03-

AC-08.1.B-03-

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA



Fri 16 Apr 1999  
Eff. Date 10/01/99

PROJECT DEER2 : U.S. Army Corps of Engineers  
DEER CREEK EARTH DAM & ROADS - Near Winchester, Northern Idaho  
EARTH DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 14:31:56  
SUMMARY PAGE 12

|                                                    | QUANTITY | UOM     | DIRECT  | F.O. Head | Home OFC | Profit | TERO TAX | BOND   | TOTAL   | UNIT   |
|----------------------------------------------------|----------|---------|---------|-----------|----------|--------|----------|--------|---------|--------|
| <hr/>                                              |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.C.10- ACCESS ROAD,CULVERTS 18"(5 EACH)     |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.C-10--02AA Culverts ~ Excavation           | 34.00    | CY      | 750     | 113       | 60       | 65     | 15       | 20     | 1,023   | 30.08  |
| AC-08.1.C-10--02BA Culverts ~ 18 Inch CMP          | 100.00   | LF      | 2,302   | 345       | 185      | 198    | 45       | 62     | 3,138   | 31.38  |
| AC-08.1.C-10--02CA Culverts ~ Backfill Bedding     | 27.00    | CY      | 2,929   | 439       | 236      | 252    | 58       | 78     | 3,993   | 147.88 |
| TOTAL ACCESS ROAD,CULVERTS-18"(5 EACH)             | 100.00   | LF      | 5,982   | 897       | 482      | 515    | 118      | 160    | 8,154   | 81.54  |
| TOTAL NEW PERM SITE ACCESS ROADS (B)               | 1050.00  | LF      | 56,383  | 8,457     | 4,438    | 4,849  | 1,112    | 1,505  | 76,744  | 73.09  |
| <hr/>                                              |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D NEW PERM-TO-TOP OF DAM A-ROAD(C)         |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-06- ACCESS ROAD,CRUSHD SURFACING MAT     |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-06--02BA Produce Surface Materials Dr&B1 | 585.00   | BCY     | 2,107   | 316       | 97       | 176    | 40       | 55     | 2,791   | 4.77   |
| AC-08.1.D-06--02BB Crushing & StoCPile Materials   | 527.00   | LCY     | 2,548   | 382       | 117      | 213    | 49       | 66     | 3,376   | 6.41   |
| TOTAL ACCESS ROAD,CRUSHD SURFACING MAT             | 390.00   | CY      | 4,655   | 698       | 214      | 390    | 89       | 121    | 6,167   | 15.81  |
| <hr/>                                              |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-07- ACCESS ROAD, PREP FOR SURFACING      |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-07--02AA Forest Roads, Grade Road Bed    | 48850    | SY      | 38,437  | 5,765     | 3,094    | 3,311  | 759      | 1,027  | 52,393  | 1.07   |
| TOTAL ACCESS ROAD, PREP FOR SURFACING              | 1735.00  | LF      | 38,437  | 5,765     | 3,094    | 3,311  | 759      | 1,027  | 52,393  | 30.20  |
| <hr/>                                              |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-08- ACCESS ROAD, 4" BASE COURSE          |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-08--02BC Load, Haul & Place Base Course  | 2320.00  | BCY     | 9,792   | 1,469     | 788      | 843    | 193      | 262    | 13,348  | 5.75   |
| TOTAL ACCESS ROAD, 4" BASE COURSE                  | 2320.00  | SY      | 9,792   | 1,469     | 788      | 843    | 193      | 262    | 13,348  | 5.75   |
| <hr/>                                              |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-09- ACCESS ROAD, 2" TOP COURSE           |          |         |         |           |          |        |          |        |         |        |
| AC-08.1.D-09--02BC Load, Haul & Place Top Course   | 116.00   | BCY     | 4,519   | 678       | 364      | 389    | 89       | 121    | 6,160   | 5.31   |
| TOTAL ACCESS ROAD, 2" TOP COURSE                   | 2320.00  | SY      | 4,519   | 678       | 364      | 389    | 89       | 121    | 6,160   | 2.66   |
| TOTAL NEW PERM-TO-TOP OF DAM A-ROAD(C)             | 1735.00  | LF      | 57,403  | 8,610     | 4,460    | 4,933  | 1,131    | 1,531  | 78,068  | 45.00  |
| TOTAL ROADS                                        | 45301    | LF      | 570,728 | 85,609    | 42,184   | 48,897 | 11,211   | 15,173 | 773,802 | 17.08  |
| TOTAL ROADS, RAILROADS, AND BRIDGES                | 8.58     | MI      | 570,728 | 85,609    | 42,184   | 48,897 | 11,211   | 15,173 | 773,802 | 90190  |
| TOTAL DEER CREEK EARTH DAM & ROADS                 | 3198383  | 475,470 | 165,798 | 268,818   | 61,636   | 83,414 | 4254119  |        |         |        |









Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
Near Winchester, Northern Idaho  
PRICE LEVEL 1 Oct 1998  
SALES TAX RATE 5.0%, TERO 1.5%  
-- FOR OFFICIAL USE ONLY --

DEER CREEK RCC DAM & ROADS

Near Winchester, Northern Idaho

PRICE LEVEL 1 Oct 1998

SALES TAX RATE 5.0%, TERO 1.5%

-- FOR OFFICIAL USE ONLY --

Designed By: Walla Walla Corp's Engineers  
Estimated By: Karl Pankaskie

Prepared By: Walla Walla Cost Engineer Branch  
Kim Callan, CHIEF, COST ENGR

Preparation Date: 04/16/99

Effective Date of Pricing: 10/01/99

Est Construction Time: 250 Days

Sales Tax: 5.00%

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Release 5.30

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

TIME 13:26:38  
TITLE PAGE 1

#### DEER CREEK DAM PROJECT DESCRIPTIONS

##### Main Dam

This option for Deer Creek Dam will be a straight-axis gravity dam structure approximately 600 feet long at the top of the dam. The dam structure will be 80 feet high measured from the deepest point in the foundation. The hydraulic head will be 70 feet measured from the assumed invert elevation of the streambed.

##### RCC Dam

This estimate consists of costs to construct a roller compacted concrete (RCC) dam. The RCC structure could incorporate RCC with an upstream precast concrete, vertical face paneling system. Between the dam and vertical face panels will be a waterproof membrane that seals up the upstream face of dam. In addition to the RCC core and vertical face panels, an 80' deep, 5' space, grout curtain will be established beneath the dam to try to reduce leakage beneath the dam. No gallery will be constructed in the RCC dam because of the low volume of RCC required.

##### Spillway

An overflow emergency spillway with a 150-foot crest length is proposed. The spillway will be constructed on the left abutment where a natural saddle would allow for an overland flow of water away from the embankment and back into the Deer Creek downstream of the dam. The spillway features are the approach channel, the formed concrete ogee (including the spillway crest), and the spillway chute.

##### Outlet Works and Impact Basin

The outlet works will consist of an intake tower with gates and controls, a 48-inch conduit, and an impact basin energy dissipater.

A low-level intake structure would be constructed upstream next to the dam, connected to the outlet conduit pipe for delivering water downstream through the dam and back into Deer Creek through an outlet structure. This concrete box structure will have two slide gates with operators to control the flow of water through the structure.

The outlet conduit pipe will include a concrete embedded 48-inch steel pipe conduit. This pipe will also be used as part of the dewater works.

The impact basin structure would be constructed downstream of the dam and connected to the outlet conduit pipe for delivering water back into the stream. The concrete box structure will have baffles to dissipate water energy and to allow proper flow back into the stream.

Conventional concrete will be used for construction of the spillway cap, training walls, conduit encasement, intake tower, impact basin structure, lift joint bedding, and foundation bedding.

##### Reservoir

The Deer Creek reservoir is approximate 1.5 miles in length. The reservoir basin area at the dam site is approximately 111 acres. Some of the reservoir is forested and will need some preparation for the water that will contained

by the dam.

**Access Road**

Approximately 14.22 miles of access roads will need some improvements. The existing dirt roads shall be leveled, graded, and compacted. Four inches of base material will be placed, graded, and compacted with two inches of gravel top course material placed, graded and compacted on top. This should provide an adequate foundation for the vehicles to access the dam site. A one-lane road with turnouts every 2,000 feet is suggested. Plate - 3 shows the locations of roads needed to be improved and new road sections that will be needed to connect them. New road sections and turnouts should be placed in the field to minimize the amount of environmental damage. As shown on plate 3, some construction roads will need to be 2 lane for construction traffic.

**BASIS OF DESIGN**

This estimate is for letter report dated May 1999 to evaluate dam alternatives for the Deer Creek Site for the Nez Perce Tribe.

**CONSTRUCTION SCHEDULE**

The contractor shall commence work under this contract within 10 calendar days of receiving the notice to proceed; prosecute said work diligently; and complete the entire work ready for use, within the time frame below:

Construction period of the road is unknown at this time.

Construction period of the reservoir is unknown at this time.

**CONSTRUCTION WINDOWS**

Construction windows of the all work are unknown at this time.

**OVERTIME**

This estimate contains overtime to complete the project because of the short construction seasons due to high mountain weather.

Overtime was used in the development for the following item costs:

- Quarry, drilling, and blasting work
- Drilling, and grouting work
- High volume earthmoving work
- High volume RCC work

The standard contingency of 20% was used for this project.

**ACQUISITION PLAN**

The three low bidding contracts are required as follows 1) constructing the main dam, 2) constructing the roadwork, and 3) clearing the reservoir.

**SUB-CONTRACTING PLAN**

The following are subcontractors on this project:

- Crushing and Batching Subcontractor (AH)
- Drilling Subcontractor (AG)
- Blasting Subcontractor (AI)
- Grouting Subcontractor (AK)
- Shotcrete Subcontractor (AL)
- Fencing Subcontractor (AF)
- Guard Rail Subcontractor (I)

Sitework Subcontractor ()  
It is assumed that the prime contractor will do the rest of the work.

#### PROJECT CONSTRUCTION

##### SITE ACCESS

Deer Creek Dam site is located on Deer Creek in Lewis County, Idaho and extends across Sections 18, 20, and 28 in T.32N, R.3 W., Boise Meridian. It is located on lands owned by the Nez Perce Tribe in the heart of Nez Perce National Forest. The site is approximately 14 miles south of Winchester, Idaho.

##### BORROW AREAS

The borrow sources for Deer Creek RCC dam is as follows:

The random fill material will be obtained from excavating the valley floor.

The sand filter, cobbles or gravel bedding, riprap or cobbles will be available by process crushing (at the same time) materials from the spillway excavation, left abutment quarry or access road quarry. Note: In the quarry site and at a depth of about 15-feet, rocks of 8-to 24-inch size are suitable to be process into riprap or cobbles.

The borrow sources for concrete aggregates will be available by process crushing material from the same sources. Cement can be hauled in and stored on site.

The water source for earth compaction, concrete, and RCC production will be available from surface water. Upstream of the RCC material sources, a small dike with a culvert will be built. The structure will be constructed to store water for earth compaction, RCC and concrete requirements. Groundwater may be a viable option; however, no active wells exist in the vicinity of the construction site. The effects of water on properties of concrete should be investigated during production of mix design trials.

##### CONSTRUCTION METHODOLOGY

The construction methodology is standard dam construction.

The site needs to be dewatered because Deer Creek runs through the dam location. A small upstream, earth dike will divert water into a pipe, which becomes a part of the outlet works.

##### UNUSUAL CONDITIONS (Soil, Water, Weather)

No unusual conditions occur at the site.

##### UNIQUE TECHNIQUES OF CONSTRUCTION

RCC will be batched at a site plant, a conveyor will transport it to a hopper at the dam, and then a loader will transport it to placement location. The RCC mix will be spread with a small dozer and compacted with a ten ton vibrating roller. This is a time / temperature operation.

EQUIPMENT AND LABOR AVAILABILITY & DISTANCE TRAVELED  
This estimate uses Davis Bacon labor rates for Lewis County, revision number:

ri 16 Apr 1999  
ff. Date 10/01/99  
PROJECT NOTES

**PROJECT DEER02:** U.S. Army Corps of Engineers  
DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE

TIME 13:26:38  
TITLE PAGE 5

11, dated 2/32/99. See the labor spread sheet for development of labor costs used in the estimate.

ENVIRONMENTAL CONCERN<sup>s</sup>  
This estimate has provisions for Monthly Anticipated Adverse Weather Delays  
as specified in the contract clauses.  
This estimate acknowledges no amendments at this time.  
This work will not be performed by a contractor under the Small Business  
Administration or program

Prices are good for the period May 1999 through October 1999. Total project costs summary spreadsheet will take care of inflation after that.

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPP ID: UP999EA

LABOR ID: NIDA99

Fri 16 Apr 1999  
Eff. Date 10/01/99  
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U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE

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No Detailed Estimate...

No Backup Reports...

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Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2 : DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - Element \*\*

TIME 13:26:38

SUMMARY PAGE 2

|                                             | QUANTITY   | UOM | DIRECT          | F-O-Head       | Home OFC       | Profit         | TERO TAX       | BOND          | TOTAL          | UNIT           |
|---------------------------------------------|------------|-----|-----------------|----------------|----------------|----------------|----------------|---------------|----------------|----------------|
| AC-08.1.B FOREST ROAD, IMPROVE EXISTING (A) | 36600 LF   | LF  | 457,331         | 68,675         | 33,327         | 39,188         | 8,985          | 12,160        | 620,166        | 16.34          |
| AC-08.1.C NEW PERM SITE ACCESS ROADS (B)    | 1050.00 LF | LF  | 55,935          | 8,390          | 4,401          | 4,811          | 1,103          | 1,493         | 76,133         | 72.51          |
| AC-08.1.D NEW PERM-TO-TOP OF DAM A-ROAD (C) | 1735.00 LF | LF  | 57,443          | 8,617          | 4,462          | 4,937          | 1,132          | 1,532         | 78,122         | 45.03          |
| <b>TOTAL ROADS</b>                          |            |     | <b>45301 LF</b> | <b>85,681</b>  | <b>42,190</b>  | <b>48,936</b>  | <b>11,220</b>  | <b>15,185</b> | <b>774,421</b> | <b>17.10</b>   |
| <b>TOTAL ROADS, RAILROADS, AND BRIDGES</b>  |            |     | <b>14.23 MI</b> | <b>571,210</b> | <b>85,681</b>  | <b>42,190</b>  | <b>48,936</b>  | <b>11,220</b> | <b>15,185</b>  | <b>774,421</b> |
| <b>TOTAL DEER CREEK RCC DAM &amp; ROADS</b> |            |     |                 | <b>3313640</b> | <b>492,669</b> | <b>171,056</b> | <b>278,416</b> | <b>63,837</b> | <b>86,392</b>  | <b>4406009</b> |

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA



Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 4

|                                                  | QUANTITY | UOM | DIRECT | F-O. Head | Home OFC | Profit | TERO TAX | BOND  | TOTAL  | UNIT          |
|--------------------------------------------------|----------|-----|--------|-----------|----------|--------|----------|-------|--------|---------------|
| AC-04.1.A-02--02LA Remove Diversion Upper Bike   | 1800.00  | CY  | 2,445  | 367       | 112      | 205    | 47       | 64    | 3,239  | 1.80          |
| TOTAL DIVERSION AND CARE OF WATER                | 240.00   | LF  | 29,272 | 4,391     | 1,347    | 2,451  | 562      | 760   | 38,783 | 161.59        |
|                                                  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.A-03- STORAGE & PONDING OF CONSTR WATER  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.A-03--02AA Diversion Conduit 48" Dia CMP | 40.00    | LF  | 3,464  | 520       | 159      | 290    | 66       | 90    | 4,589  | 114.72        |
| AC-04.1.A-03--02BA Diversion Conduit Upper Dike  | 1800.00  | CY  | 1,601  | 240       | 74       | 134    | 31       | 42    | 2,122  | 1.18          |
| AC-04.1.A-03--02CA Remove D Conduit 48" Dia CMP  | 40.00    | LF  | 606    | 91        | 28       | 51     | 12       | 16    | 803    | 20.08         |
| AC-04.1.A-03--02KA Remove Diversion Upper Dike   | 1800.00  | CY  | 2,315  | 347       | 106      | 194    | 44       | 60    | 3,067  | 1.70          |
| TOTAL STORAGE & PONDING OF CONSTR WATER          | 1.00     | EA  | 7,986  | 1,198     | 367      | 669    | 153      | 207   | 10,581 | 10581         |
| TOTAL MOB., DEMOB., AND PREWORK                  | 148,711  |     | 22,307 | 6,841     | 12,450   | 2,855  | -----    | ----- | 3,863  | 197,026       |
|                                                  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C SITE ACCESS ROADS & PARKING            |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-03- SITE FENCING                       |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-03--02BA 6' Site Fencing               | 630.00   | LF  | 13,396 | 2,009     | 616      | 1,122  | 257      | 348   | 17,749 | 28.17         |
| AC-04.1.C-03--02BC 6' Site Fencing Gates         | 3.00     | EA  | 3,123  | 468       | 144      | 261    | 60       | 81    | 4,137  | 1379.13       |
| TOTAL SITE FENCING                               | 630.00   | LF  | 16,519 | 2,478     | 760      | 1,383  | 317      | 429   | 21,886 | 34.74         |
|                                                  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-04- DECK FENCING                       |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-04--02BA Deck Fencing Right Side       | 610.00   | LF  | 25,705 | 3,856     | 1,182    | 2,152  | 493      | 668   | 34,056 | 55.83         |
| AC-04.1.C-04--02BB Deck Fencing Left Side        | 610.00   | LF  | 24,826 | 3,724     | 1,142    | 2,078  | 477      | 645   | 32,892 | 53.92         |
| TOTAL DECK FENCING                               | 1220.00  | LF  | 50,531 | 7,580     | 2,324    | 4,230  | 970      | 1,313 | 66,948 | 54.88         |
|                                                  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-05- DRYLAND GRASS ESTABLISHMENT        |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-05--02BA Dryland Grass Establishment   | 3.00     | ACR | 6,300  | 945       | 290      | 527    | 121      | ----- | 164    | 8,347 2782.28 |
| TOTAL DRYLAND GRASS ESTABLISHMENT                | 3.00     | ACR | 6,300  | 945       | 290      | 527    | 121      | ----- | 164    | 8,347 2782.28 |
|                                                  |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-06- CULVERTS - 18 INCH (1 EACH)        |          |     |        |           |          |        |          |       |        |               |
| AC-04.1.C-06--02AA Culverts - Excavation         | 7.00     | CY  | 192    | 29        | 9        | 16     | 4        | 5     | 255    | 36.42         |
| AC-04.1.C-06--02BA Culverts - 18 Inch CMP        | 20.00    | LF  | 400    | 60        | 18       | 33     | 8        | 10    | 530    | 26.49         |
| AC-04.1.C-06--02CA Culverts - Backfill Bedding   | 5.00     | CY  | 508    | 76        | 23       | 43     | 10       | 13    | 673    | 134.61        |
| TOTAL CULVERTS - 18 INCH (1 EACH)                | 20.00    | LF  | 1,100  | 165       | 51       | 92     | 21       | 29    | 1,458  | 72.88         |
|                                                  |          |     |        |           |          |        |          |       |        |               |

LABOR ID: NIDA99 EQUIP ID: NAT9A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEER2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 5

|                                                      | QUANTITY       | UOM           | DIRECT        | F.O. Head    | Home         | OFc          | Profit       | TERO TAX     | BOND          | TOTAL          | UNIT |
|------------------------------------------------------|----------------|---------------|---------------|--------------|--------------|--------------|--------------|--------------|---------------|----------------|------|
| <b>TOTAL TRIANGULATION SURVEY</b>                    |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.C-11- TRIANGULATION SURVEY                   |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.C-11--02BA Trilateration Caps on Rock        | 2.00           | EA            | 447           | 67           | 21           | 37           | 9            | 12           | 592           | 296.24         |      |
| AC-04.1.C-11--02BB Trilateration Caps in Soil        | 1.00           | EA            | 505           | 76           | 42           | 10           | 13           | 670          | 669.50        |                |      |
| AC-04.1.C-11--02BC Survey Markers on RCC Dam         | 7.00           | EA            | 1,503         | 225          | 69           | 126          | 29           | 39           | 1,991         | 284.50         |      |
| AC-04.1.C-11--02BD Survey ( Trilateration Survey )   | 4.00           | DAY           | 1,963         | 294          | 90           | 164          | 38           | 51           | 2,601         | 650.26         |      |
| <b>TOTAL TRIANGULATION SURVEY</b>                    | <b>3.00</b>    | <b>EA</b>     | <b>4,419</b>  | <b>663</b>   | <b>203</b>   | <b>370</b>   | <b>85</b>    | <b>115</b>   | <b>5,855</b>  | <b>1951.50</b> |      |
| <b>AC-04.1.C-12- SITE ACCESS &amp; HAUL ROADS</b>    |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.C-12--02DA Constr Road D1, Grade Road Bed    | 12w            | 1751.00       | SY            | 1,729        | 259          | 80           | 145          | 33           | 45            | 2,290          | 1.31 |
| AC-04.1.C-12--02DC Constr Road D2, Grade Road Bed    | 220.00         | SY            | 2,883         | 432          | 133          | 241          | 55           | 75           | 3,819         | 1.31           |      |
| AC-04.1.C-12--02EA Constr Road E, Grade Road Bed     | 12w            | 1390.00       | SY            | 1,372        | 206          | 63           | 115          | 26           | 36            | 1,818          | 1.31 |
| AC-04.1.C-12--02FA Constr Road F, Grade Road Bed     | 12w            | 800.00        | SY            | 790          | 118          | 36           | 66           | 15           | 21            | 1,046          | 1.31 |
| AC-04.1.C-12--02GA Constr Road G, Grade Road Bed     | 12w            | 630.00        | SY            | 622          | 93           | 29           | 52           | 12           | 16            | 824            | 1.31 |
| AC-04.1.C-12--02HA Constr Road H, Grade Road Bed     | 20w            | 2333.00       | SY            | 2,303        | 345          | 106          | 193          | 44           | 60            | 3,051          | 1.31 |
| <b>TOTAL SITE ACCESS &amp; HAUL ROADS</b>            | <b>45250</b>   | <b>LF</b>     |               |              |              |              |              |              |               |                |      |
| <b>TOTAL SITE ACCESS ROADS &amp; PARKING</b>         | <b>88,568</b>  | <b>13,285</b> |               | <b>4,074</b> | <b>7,415</b> | <b>1,812</b> | <b>186</b>   | <b>252</b>   | <b>12,849</b> | <b>0.28</b>    |      |
| <b>AC-04.1.D EARTHWORK FOR STRUCTURES</b>            |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.D-12A EXCAVATION UNCLASF                     |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.D-12A-02AA Excavation and Strip Foundation   | 5220.00        | SY            | 27,477        | 4,122        | 1,264        | 2,300        | 527          | 714          | 36,404        | 6.97           |      |
| AC-04.1.D-12A-02BA Excavation and Haul Common        | 5200.00        | BCY           | 13,297        | 1,995        | 612          | 1,113        | 255          | 345          | 17,617        | 3.39           |      |
| AC-04.1.D-12A-02BC Excavation and Trim Common        | 1000.00        | BCY           | 1,540         | 231          | 71           | 129          | 30           | 40           | 2,040         | 2.04           |      |
| AC-04.1.D-12A-02BB RIP Rock                          | 300.00         | BCY           | 1,360         | 204          | 63           | 114          | 26           | 35           | 1,802         | 6.01           |      |
| AC-04.1.D-12A-02BD Blast Boulders                    | 18.00          | BCY           | 1,018         | 153          | 47           | 85           | 20           | 26           | 1,349         | 74.92          |      |
| AC-04.1.D-12A-02BE Load & Haul Ripped & Blasted Rock | 300.00         | BCY           | 819           | 123          | 38           | 69           | 16           | 21           | 1,084         | 3.61           |      |
| AC-04.1.D-12A-02BF Maintain Haul Roads               | 5500.00        | BCY           | 6,707         | 1,006        | 309          | 562          | 129          | 174          | 8,886         | 1.62           |      |
| <b>TOTAL EXCAVATION, UNCLASF</b>                     | <b>5500.00</b> | <b>CY</b>     | <b>52,217</b> | <b>7,833</b> | <b>2,402</b> | <b>4,372</b> | <b>1,002</b> | <b>1,357</b> | <b>69,183</b> | <b>12.58</b>   |      |
| <b>TOTAL EARTHWORK FOR STRUCTURES</b>                | <b>6400.00</b> | <b>CY</b>     | <b>52,217</b> | <b>7,833</b> | <b>2,402</b> | <b>4,372</b> | <b>1,002</b> | <b>1,357</b> | <b>69,183</b> | <b>10.81</b>   |      |
| <b>AC-04.1.E FOUNDATION WORK</b>                     |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.E-16A EXPLORATORY DRILLING                   |                |               |               |              |              |              |              |              |               |                |      |
| AC-04.1.E-16A-02BA Nx Exploratory Drilling           | 200.00         | LF            | 17,817        | 2,673        | 820          | 1,492        | 342          | 463          | 23,606        | 118.03         |      |
| <b>TOTAL EXPLORATORY DRILLING</b>                    | <b>200.00</b>  | <b>LF</b>     | <b>17,817</b> | <b>2,673</b> | <b>820</b>   | <b>1,492</b> | <b>342</b>   | <b>463</b>   | <b>23,606</b> | <b>118.03</b>  |      |
| <b>AC-04.1.E-17A PRESSURE TESTING NX HOLE</b>        |                |               |               |              |              |              |              |              |               |                |      |
| LABOR ID: NTDA99 EQUIP ID: NAT97A                    |                |               |               |              |              |              |              |              |               |                |      |
| Currency in DOLLARS                                  |                |               |               |              |              |              |              |              |               |                |      |

CREW ID: NAT97A UPB ID: UP99EA

Currency in DOLLARS

Fri 16 Apr 1999  
EFF. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERGC2 : DEER GREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK - BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 6

|                                             | QUANTITY | UOM | DIRECT | F-O Head | Home OFC | Profit | TERO TAX | BOND | TOTAL | UNIT  |       |
|---------------------------------------------|----------|-----|--------|----------|----------|--------|----------|------|-------|-------|-------|
| AC-04-1.E-17A-02BA Pressure Testing NX Hole | 200.00   | MIN | 1,600  | 240      | 74       | -      | 134      | 31   | 42    | 2,120 | 10.60 |
| TOTAL PRESSURE TESTING NX HOLE              | 200.00   | MIN | 1,600  | 240      | 74       | -      | 134      | 31   | 42    | 2,120 | 10.60 |

THE CIVILIAN PROTECTION FORCE

C-04.1.E-19A FOUNDATION CLEANUP  
C-04.1.E-19A-02BA Foundation Cleanup

TOTAL FOUNDATION CLEANUP 4240.00 SY 61,101 9,165 2,811 5,115 1,173 1,587 80,953 19.09

C-04.1.E-22A FOUND.TREAT.DRILL.GROUT.CURTAIN  
C-04.1.E-22A-02BA Drill Foundation Grout Curtain

TOTAL FOUND.TREAT.DRILL.GROUT.CURTAIN 6400.00 LF 73,035 10,955 3,360 6,114 1,402 1,897 96,763 15.12

C-04-1.E-23A FOUND.TREAT.DRILL HOLE SETUPS  
C-04-1.E-23A-03AA Grout Holes Setups  
TOTAL FOUND TREAT DRILL HOLE SETUPS

|  | 240.00 EA | 23,810 | 3,571 | 1,095 | 1,993 | 457   | 619   | 31,546 | 131.44 |
|--|-----------|--------|-------|-------|-------|-------|-------|--------|--------|
|  | -----     | -----  | ----- | ----- | ----- | ----- | ----- | -----  | -----  |
|  | 240.00 EA | 23,810 | 3,571 | 1,095 | 1,993 | 457   | 619   | 31,546 | 131.44 |

CULTURE, HISTORY, AND THE STATE IN CHINESE LITERATURE

| C-04-1-E-24A                           | FOUND.TREAT.WATER PRESSURE TESTG |
|----------------------------------------|----------------------------------|
| C-04-1-E-24A-03BA                      | Water Pressure Testing           |
| 240.00 EA                              | 18.726                           |
|                                        | 2.809                            |
|                                        | 861                              |
|                                        | 1,568                            |
|                                        | 359                              |
|                                        | 486                              |
|                                        | 24.809                           |
|                                        | 103.37                           |
| TOTAL FOUND.TREAT.WATER PRESSURE TESTG |                                  |
| 240.00 EA                              | 18.726                           |
|                                        | 2.809                            |
|                                        | 861                              |
|                                        | 1,568                            |
|                                        | 359                              |
|                                        | 486                              |
|                                        | 24.809                           |
|                                        | 103.37                           |

| C-04 .1 E-25A FOUND.TREAT.GROUT QUANTITIES |                    |                              |             |        |       |
|--------------------------------------------|--------------------|------------------------------|-------------|--------|-------|
| C-04 .1 E-25A                              | C-04 .1 E-25A-03AA | Cement Grout HRWRA Admixture | 720.00 GAL  | 13,305 | 1,996 |
| C-04 .1 E-25A-03CA                         | Cement Bulk Grout  |                              | 4515.00 CWT | 25,668 | 3,850 |
|                                            |                    |                              |             |        |       |

TOTAL FOUND.TREAT.GROUT QUANTITIES

C-04 .1 .E-26 - DENTAL CONCRETE  
C-04 .1 .E-26 --03CA Dental Concrete

TOTAL DENTAL CONCRETE 200.00 CY 30,503 4,576 1,403 2,554 586 792 40,414 202.07

|                       |          |         |        |        |        |       |       |         |       |
|-----------------------|----------|---------|--------|--------|--------|-------|-------|---------|-------|
| TOTAL FOUNDATION WORK | 20000 SF | 265,564 | 39,835 | 12,216 | 22,233 | 5,098 | 6,899 | 351,845 | 17,59 |
|-----------------------|----------|---------|--------|--------|--------|-------|-------|---------|-------|

C-04-1.S ROLLER COMPAKTED CONCRETE DAM

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CREW ID: NA19/A      UFB ID: UF99EA

CURRENCY IN DOLLARS

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 7

|                                       | QUANTITY                        | UOM                            | DIRECT          | F.O. Head      | Home OFC | Profit  | TERO TAX | BOND    | TOTAL  | UNIT   |
|---------------------------------------|---------------------------------|--------------------------------|-----------------|----------------|----------|---------|----------|---------|--------|--------|
| AC-04.1.S-23- RCC TEST PLACEMENT      |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-23--02AZ                    | RCC                             | Drill, Shot & Producing        | 239.00          | CY             | 2,642    | 396     | 122      | 221     | 51     | 69     |
| AC-04.1.S-23--02BB                    | RCC                             | Crushing & Stockpile Materials | 440.01          | CY             | 2,194    | 329     | 101      | 184     | 42     | 57     |
| AC-04.1.S-23--03BC                    | Water for RCC                   |                                | 7.27            | MGL            | 290      | 44      | 13       | 24      | 6      | 8      |
| AC-04.1.S-23--03CA                    | RCC Concrete                    | 1. Test Slab,5 Strip           | 300.00          | CY             | 19,892   | 2,984   | 915      | 1,665   | 382    | 517    |
| AC-04.1.S-23--03CB                    | Remove RCC Conc.,1 Slab,5 Strip |                                | 300.00          | CY             | 1,197    | 179     | 55       | 100     | 23     | 31     |
| TOTAL RCC TEST PLACEMENT              |                                 |                                | 300.00          | CY             | 26,215   | 3,932   | 1,206    | 2,195   | 503    | 681    |
| AC-04.1.S-24A RCC CONCRETE            |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-24A-01AA                    | RCC Conc.                       | Downstream Safety Rail         | 150.00          | LF             | 3,625    | 544     | 167      | 304     | 70     | 94     |
| AC-04.1.S-24A-02AZ                    | RCC Conc.                       | Drill, Shot & Prod Mat         | 350301          | CY             | 198,616  | 29,792  | 9,136    | 16,628  | 3,813  | 5,160  |
| AC-04.1.S-24A-02BB                    | RCC Conc.                       | Crushing &Stockpile Mat        | 593030          | LCY            | 292,851  | 43,928  | 13,471   | 24,517  | 5,622  | 7,608  |
| AC-04.1.S-24A-03BC                    | RCC Conc.                       | Water for RCC                  | 1024.00         | MGL            | 28,974   | 4,346   | 1,333    | 2,426   | 556    | 753    |
| AC-04.1.S-24A-03BD                    | RCC Conc.                       | Blend Sand for RCC             | 4590.00         | CY             | 10,881   | 1,632   | 501      | 911     | 209    | 283    |
| AC-04.1.S-24A-03CF                    | RCC Conc.                       | Placing RCC Mix                | 44000           | CY             | 724,078  | 108,612 | 33,308   | 60,620  | 13,899 | 18,810 |
| TOTAL RCC CONCRETE                    |                                 |                                | 44000           | CY             | 1259025  | 188,854 | 57,915   | 105,406 | 24,168 | 32,707 |
| AC-04.1.S-25A CEMENT FOR RCC CONCRETE |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-25A-03CA                    | Cement for RCC                  |                                | 56166           | CWT            | 206,410  | 30,962  | 9,495    | 17,281  | 3,962  | 5,362  |
| TOTAL CEMENT FOR RCC CONCRETE         |                                 |                                | 56166           | CWT            | 206,410  | 30,962  | 9,495    | 17,281  | 3,962  | 5,362  |
| AC-04.1.S-26A AIR ENTRAIN ADM. RCC    |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-26A-03CA                    | Air Entrain                     | Adm.RCC                        | 236.00          | GAL            | 1,016    | 152     | 47       | 85      | 20     | 26     |
| TOTAL AIR ENTRAIN ADM. RCC            |                                 |                                | 236.00          | GAL            | 1,016    | 152     | 47       | 85      | 20     | 26     |
| AC-04.1.S-27A WATER REDUC ADM.RCC     |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-27A-03CA                    | Water Reduc                     | Adm.RCC                        | 6144.00         | GAL            | 48,384   | 7,258   | 2,226    | 4,051   | 929    | 1,257  |
| TOTAL WATER REDUC ADM.RCC             |                                 |                                | 6144.00         | GAL            | 48,384   | 7,258   | 2,226    | 4,051   | 929    | 1,257  |
| AC-04.1.S-29A VERT.FACING SYSTEM DAM  |                                 |                                |                 |                |          |         |          |         |        |        |
| AC-04.1.S-29A-03CA                    | Vert.Facing System              |                                | 2871.00         | SY             | 248,456  | 37,268  | 11,429   | 20,801  | 4,769  | 6,454  |
| AC-04.1.S-29A-03CC                    | Vert.Facing System              | Starter Slab                   | 100.00          | CY             | 23,884   | 3,503   | 1,099    | 2,000   | 458    | 620    |
| TOTAL VERT.FACING SYSTEM DAM          |                                 |                                | 2871.00         | SY             | 272,340  | 40,851  | 12,528   | 23,800  | 5,228  | 7,075  |
| Currency in DOLLARS                   |                                 |                                |                 |                |          |         |          |         |        |        |
| LABOR ID: NIDA99                      | EQUIP ID: NAT97A                |                                | CREW ID: NAT97A | UPB ID: UP99EA |          |         |          |         |        |        |

Fri 16 Apr 1999  
Eff. Date 10/01/99

PROJECT DEERC2 : U.S. Army Corps of Engineers  
DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 8

|                                     | QUANTITY | UOM | DIRECT  | F-O-Head | Home    | OFC     | Profit | TERO TAX | BOND    | TOTAL | UNIT |
|-------------------------------------|----------|-----|---------|----------|---------|---------|--------|----------|---------|-------|------|
| TOTAL ROLLER COMPACTED CONCRETE DAM | 44000    | CY  | 1813390 | 272,008  | 83,416  | 151,817 | 34,809 | 47,109   | 2402550 | 54,60 |      |
| TOTAL MAIN DAM                      | 44000    | CY  | 2368451 | 355,268  | 108,949 | 198,287 | 45,464 | 61,528   | 3137946 | 71.32 |      |

AC-04.2 SPILLWAY

AC-04.2.9 EARTHWORK FOR STRUCTURES

AC-04.2.9-11A EXCAVATION, UNCLASF

|                                                      |         |     |        |       |       |       |     |       |        |       |
|------------------------------------------------------|---------|-----|--------|-------|-------|-------|-----|-------|--------|-------|
| AC-04.2.9-11A-02AA Excavation and Strip Foundation   | 5220.00 | SY  | 27,477 | 4,122 | 1,264 | 2,300 | 527 | 714   | 36,404 | 6.97  |
| AC-04.2.9-11A-02BA Excavation and Haul Common        | 5080.00 | BCY | 15,588 | 2,338 | 717   | 1,305 | 299 | 405   | 20,653 | 4.07  |
| AC-04.2.9-11A-02BB Excavation and Trim Common        | 1000.00 | BCY | 1,540  | 231   | 71    | 129   | 30  | 2,040 | 2,040  | 2.04  |
| AC-04.2.9-11A-02BC Rip Rock                          | 300.00  | BCY | 1,360  | 204   | 63    | 114   | 26  | 35    | 1,802  | 6.01  |
| AC-04.2.9-11A-02BD Blast Boulders                    | 12.00   | BCY | 679    | 102   | 31    | 57    | 13  | 18    | 899    | 74.92 |
| AC-04.2.9-11A-02BE Load & Haul Ripped & Blasted Rock | 300.00  | BCY | 819    | 123   | 38    | 69    | 16  | 21    | 1,084  | 3.61  |
| TOTAL EXCAVATION, UNCLASF                            | 3700.00 | CY  | 47,462 | 7,119 | 2,183 | 3,974 | 911 | 1,233 | 62,882 | 17.00 |

AC-04.2.9-12A EXCAVATION, ROCK EXCAVATION

|                                                 |         |    |        |       |       |       |       |         |        |       |
|-------------------------------------------------|---------|----|--------|-------|-------|-------|-------|---------|--------|-------|
| AC-04.2.9-12A-02BC Presplit Rock, Drill, & Shot | 1400.00 | LF | 31,185 | 4,678 | 1,434 | 2,611 | 599   | 810     | 41,316 | 29.51 |
| TOTAL EXCAVATION, ROCK EXCAVATION               | 9120.00 | CY | 31,185 | 4,678 | 1,434 | 2,611 | 599   | 810     | 41,316 | 4.53  |
| TOTAL EARTHWORK FOR STRUCTURES                  | 78,647  |    | 11,797 | 3,618 | 6,584 | 1,510 | 2,043 | 104,199 |        |       |

AC-04.2.A FOUNDATION WORK

AC-04.2.A-19A FOUNDATION CLEANUP

|                                       |        |    |       |     |    |     |    |    |       |       |
|---------------------------------------|--------|----|-------|-----|----|-----|----|----|-------|-------|
| AC-04.2.A-19A-02BA Foundation Cleanup | 150.00 | SY | 1,948 | 292 | 90 | 163 | 37 | 51 | 2,580 | 17.20 |
| TOTAL FOUNDATION CLEANUP              | 150.00 | SY | 1,948 | 292 | 90 | 163 | 37 | 51 | 2,580 | 17.20 |
| TOTAL FOUNDATION WORK                 |        |    | 1,948 | 292 | 90 | 163 | 37 | 51 | 2,580 |       |

AC-04.2.F CONCRETE OVERFLOW SECTION

AC-04.2.F-20- CONCRETE OVERFLOW SECTION

|                                                   |        |    |        |        |       |       |       |       |        |        |
|---------------------------------------------------|--------|----|--------|--------|-------|-------|-------|-------|--------|--------|
| AC-04.2.F-20--03CA Concrete Overflow Section      | 245.00 | CY | 45,711 | 6,857  | 2,103 | 3,827 | 877   | 1,187 | 60,562 | 247.19 |
| AC-04.2.F-20--03DA Concrete Retaining Walls Slabs | 15.00  | CY | 3,863  | 579    | 178   | 323   | 74    | 100   | 5,118  | 341.20 |
| AC-04.2.F-20--03DD Concrete Retaining Walls       | 50.00  | CY | 18,756 | 2,813  | 863   | 1,570 | 360   | 487   | 24,850 | 497.00 |
| TOTAL CONCRETE OVERFLOW SECTION                   | 355.00 | CY | 68,330 | 10,249 | 3,143 | 5,721 | 1,312 | 1,775 | 90,530 | 255.01 |

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

PROJECT DEERC2 : U.S. Army Corps of Engineers  
DEER CREEK R/C DAM & ROADS - Near Winchester, Northern Idaho  
RC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 11:26:18  
SUMMARY PAGE 9

|                                                      | QUANTITY | UOM | DIRECT  | F-O-Head | Home OFC | Profit | TERO TAX | BOND  | TOTAL   | UNIT   |
|------------------------------------------------------|----------|-----|---------|----------|----------|--------|----------|-------|---------|--------|
| TOTAL CONCRETE OVERFLOW SECTION                      |          |     |         |          |          |        |          |       |         |        |
| TOTAL SPILLWAY                                       | 1.00     | EA  | 148,924 | 22,339   | 6,851    | 12,468 | 2,859    | 3,869 | 197,309 | 197309 |
| TOTAL APPROACH AND OUTLET CHANNELS                   |          |     |         |          |          |        |          |       |         |        |
| AC-04.3 OUTLET WORKS                                 |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.1 APPROACH AND OUTLET CHANNELS               |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.1-35- CONCRETE OUTLET & IMPACT BASIN         |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.1-35--02BG Outlet Channel Rip Rap,20" Thick  | 100.00   | ECY | 9,155   | 1,373    | 421      | 766    | 176      | 238   | 12,130  | 121.30 |
| AC-04.3.1-35--01CC Concr. Impact Basin Slab          | 5.00     | CY  | 1,591   | 239      | 73       | 133    | 31       | 41    | 2,108   | 421.56 |
| AC-04.3.1-35--03CD Concr. Impact Basin Wall & Baffle | 15.00    | CY  | 8,976   | 1,331    | 408      | 743    | 170      | 231   | 11,759  | 783.44 |
| AC-04.3.1-35--03CE Concr. Impact Basin Precast Slab  | 2.00     | CY  | 942     | 141      | 43       | 79     | 18       | 24    | 1,249   | 624.29 |
| TOTAL CONCRETE OUTLET & IMPACT BASIN                 | 1.00     | EA  | 20,564  | 3,085    | 946      | 1,722  | 395      | 534   | 27,246  | 27246  |
| TOTAL APPROACH AND OUTLET CHANNELS                   | 1.00     | EA  | 20,564  | 3,085    | 946      | 1,722  | 395      | 534   | 27,246  | 27246  |
| AC-04.3.3 CONDUIT OR TUNNEL                          |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.3-33- OUTLET CONDUIT ( 48" DIA. PIPE )       |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.3-33-02QA Outlet Conduit ( 48" Dia. Pipe )   | 92.00    | LF  | 16,941  | 2,541    | 779      | 1,418  | 325      | 440   | 22,445  | 243.97 |
| TOTAL OUTLET CONDUIT ( 48" DIA. PIPE )               | 92.00    | LF  | 16,941  | 2,541    | 779      | 1,418  | 325      | 440   | 22,445  | 243.97 |
| AC-04.3.3-34A OUTLET CONDUIT CONCRETE                |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.3-34A-03CA Outlet Conduit Concrete           | 83.00    | CY  | 14,037  | 2,105    | 646      | 1,175  | 269      | 365   | 18,597  | 224.06 |
| TOTAL OUTLET CONDUIT CONCRETE                        | 83.00    | CY  | 14,037  | 2,105    | 646      | 1,175  | 269      | 365   | 18,597  | 224.06 |
| TOTAL CONDUIT OR TUNNEL                              | 92.00    | LF  | 30,978  | 4,647    | 1,425    | 2,593  | 595      | 805   | 41,042  | 446.11 |
| AC-04.3.4 INTAKE STRUCTURE                           |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.4-32- INTAKE STRUCTURE                       |          |     |         |          |          |        |          |       |         |        |
| AC-04.3.4-32--02CA Intake Tower Foundation Slab      | 16.00    | CY  | 3,357   | 504      | 154      | 281    | 64       | 87    | 4,447   | 277.96 |
| AC-04.3.4-32--03CB Intake Tower Walls                | 36.00    | CY  | 23,491  | 3,524    | 1,081    | 1,967  | 451      | 610   | 31,123  | 864.52 |
| AC-04.3.4-32--01CC Intake Tower Elevated Slab        | 2.00     | CY  | 1,801   | 270      | 83       | 151    | 35       | 47    | 2,386   | 113.04 |
| AC-04.3.4-32--03CD Slide Gate Controller Slab        | 4.00     | CY  | 2,649   | 397      | 122      | 222    | 51       | 69    | 3,509   | 877.26 |
| AC-04.3.4-32--05EB Intake Tower Trashracks           | 170.00   | LB  | 6,698   | 1,005    | 308      | 561    | 129      | 174   | 8,875   | 5.01   |
| AC-04.3.4-32--15QA 24 x 24' Slide Gate & Controller  | 2.00     | EA  | 47,987  | 7,064    | 2,166    | 3,443  | 904      | 1,223 | 62,398  | 31199  |
| AC-04.3.4-32--15QB 12" Dia. Vent Pipe                | 75.00    | LF  | 873     | 131      | 40       | 73     | 17       | 23    | 1,157   | 15.42  |

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UFB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK, BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 10

|                                        | QUANTITY | UOM | DIRECT  | F-O-Head | Home OFC | Profit  | TERO TAX | BOND   | TOTAL   | UNIT    |
|----------------------------------------|----------|-----|---------|----------|----------|---------|----------|--------|---------|---------|
| TOTAL INTAKE STRUCTURE                 | 45.00    | VLF | 85,965  | 12,895   | 3,954    | 7,197   | 1,650    | 2,233  | 113,884 | 2530.99 |
| TOTAL INTAKE STRUCTURE                 | 45.00    | VLF | 85,965  | 12,895   | 3,954    | 7,197   | 1,650    | 2,233  | 113,884 | 2530.99 |
| TOTAL OUTLET WORKS                     | 92.00    | LF  | 137,507 | 20,626   | 6,325    | 11,512  | 2,640    | 3,572  | 162,182 | 1980.24 |
| TOTAL DAMS (ROLLER COMPACTED CONCRETE) | 44000    | CY  | 2654882 | 398,232  | 122,125  | 222,267 | 50,963   | 68,969 | 3517437 | 79.94   |

AC-08 ROADS, RAILROADS, AND BRIDGES

AC-08.1 ROADS

AC-08.1.B FOREST ROAD, IMPROVE EXISTING(A)

AC-08.1.B-02- FOREST ROAD, CRUSHD SURFACING MAT

|                                                    |            |         |        |       |       |       |       |         |       |
|----------------------------------------------------|------------|---------|--------|-------|-------|-------|-------|---------|-------|
| AC-08.1.B-02--02BA Produce Surface Materials Dr&BL | 12750 BCY  | 46,799  | 7,020  | 2,153 | 3,918 | 898   | 1,216 | 62,003  | 4,86  |
| AC-08.1.B-02--02BB Crushing & Stockpile Materials  | 11475 LCY  | 55,486  | 8,323  | 2,552 | 4,645 | 1,065 | 1,441 | 73,513  | 6.41  |
| TOTAL FOREST ROAD,CRUSHD SURFACING MAT             | 8500.00 CY | 102,285 | 15,343 | 4,705 | 8,563 | 1,963 | 2,657 | 135,517 | 15.94 |

AC-08.1.B-03- FOREST ROAD, PREP FOR SURFACING

|                                                 |          |        |       |       |       |     |       |        |      |
|-------------------------------------------------|----------|--------|-------|-------|-------|-----|-------|--------|------|
| AC-08.1.B-03--02AA Forest Roads, Grade Road Bed | 48850 SY | 38,437 | 5,765 | 3,094 | 3,311 | 759 | 1,027 | 52,393 | 1.07 |
| TOTAL FOREST ROAD, PREP FOR SURFACING           | 36600 LF | 38,437 | 5,765 | 3,094 | 3,311 | 759 | 1,027 | 52,393 | 1.43 |

AC-08.1.B-04- FOREST ROAD, 4" BASE COURSE

|                                                   |           |         |        |        |        |       |       |         |      |
|---------------------------------------------------|-----------|---------|--------|--------|--------|-------|-------|---------|------|
| AC-08.1.B-04--02BC Load, Haul & Place Base Course | 49050 BCY | 211,657 | 31,749 | 17,038 | 18,231 | 4,180 | 5,657 | 288,513 | 5.88 |
| TOTAL FOREST ROAD, 4" BASE COURSE                 | 49050 SY  | 211,657 | 31,749 | 17,038 | 18,231 | 4,180 | 5,657 | 288,513 | 5.88 |

AC-08.1.B-05- FOREST ROAD, 2" TOP COURSE

|                                                  |           |         |        |        |        |       |        |         |       |
|--------------------------------------------------|-----------|---------|--------|--------|--------|-------|--------|---------|-------|
| AC-08.1.B-05--02BC Load, Haul & Place Top Course | 24525 BCY | 105,452 | 15,818 | 8,489  | 9,083  | 2,083 | 2,818  | 143,743 | 5.86  |
| TOTAL FOREST ROAD, 2" TOP COURSE                 | 49050 SY  | 105,452 | 15,818 | 8,489  | 9,083  | 2,083 | 2,818  | 143,743 | 2.93  |
| TOTAL FOREST ROAD, IMPROVE EXISTING(A)           | 16600 LF  | 457,831 | 68,675 | 33,327 | 39,188 | 8,985 | 12,160 | 620,166 | 16.94 |

AC-08.1.C NEW PERM SITE ACCESS ROADS (B)

AC-08.1.C-06- ACCESS ROAD,CRUSHD SURFACING MAT

|                                                    |            |       |     |    |     |    |    |       |      |
|----------------------------------------------------|------------|-------|-----|----|-----|----|----|-------|------|
| AC-08.1.C-06--02BA Produce Surface Materials Dr&BL | 368.00 BCY | 1,351 | 203 | 62 | 113 | 26 | 35 | 1,790 | 4.86 |
|----------------------------------------------------|------------|-------|-----|----|-----|----|----|-------|------|

LABOR ID: NIDA99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UPB ID: UP99EA

Fri 16 Apr 1999  
Off. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & RODS - NEAR  
RCC DAM FOR DEER CREEK, BUDGET EST  
\*\* PROJECT INDIRECT SUMMARY - IND C

chester, Northern Idaho  
TE \*\*

TIME 13:26:38  
SUMMARY PAGE 11

|                    |                                         | QUANTITY | UOM | DIRECT | F-O-Head | Home OFC | Profit | TERO TAX | BOND | TOTAL | UNIT  |
|--------------------|-----------------------------------------|----------|-----|--------|----------|----------|--------|----------|------|-------|-------|
| AC-08.1.C-06--02BB | Crushing & Stockpile Materials          | 331.00   | LCY | 1,601  | 240      | 74       | 134    | 31       | 42   | 2,121 | .41   |
|                    | TOTAL ACCESS ROAD CRUSHED SURFACING MAT | 245.00   | CY  | 2,951  | 443      | 136      | 247    | 57       | 77   | 3,910 | 15.96 |

AC-08.1.C-07--02AA Forest Roads, Grade Roa

卷之三

AC-08.1.C-08 - ACCESS ROAD, 4" BASE COURSE

| TOTAL ACCESS ROAD, 2" TOP COURSE         | 1400.00 SY | 3,013  | 452   | 243   | 260   | 60    | 81    | 4,107  | 2.93   |
|------------------------------------------|------------|--------|-------|-------|-------|-------|-------|--------|--------|
| ACCESS ROAD, CULVERTS-18" (5 EACH)       |            |        |       |       |       |       |       |        |        |
| 02AA Culverts - Excavation               | 34.00 CY   | 750    | 113   | 60    | 65    | 15    | 20    | 1,023  | 30.08  |
| 02BA Culverts - 18 Inch CMP              | 100.00 LF  | 1,999  | 300   | 161   | 172   | 39    | 53    | 2,725  | 27.25  |
| 02CA Culverts - Backfill Bedding         | 27.00 CY   | 2,759  | 414   | 222   | 238   | 54    | 74    | 3,761  | 139.29 |
| TOTAL ACCESS ROAD, CULVERTS-18" (5 EACH) | 100.00 LF  | 5,509  | 826   | 443   | 474   | 109   | 147   | 7,509  | 75.09  |
| TOTAL NEW PERM SITE ACCESS ROADS (B)     | 1050.00 LF | 55,935 | 8,390 | 4,401 | 4,811 | 1,103 | 1,493 | 76,133 | 72.51  |

AC-08.1.D NEW PERM-TO-TOP OF DAM A-ROAD(C)

AC=08.1.D-08 - ACCESS ROAD, CRUSHED SURFACING MAI

|       |                                    |        |     |       |     |     |     |    |     |       |       |
|-------|------------------------------------|--------|-----|-------|-----|-----|-----|----|-----|-------|-------|
| 02BB  | Crushing & Stockpile Materials     | 527.00 | LCY | 2,548 | 382 | 117 | 213 | 49 | 66  | 3,376 | 6.41  |
| TOTAL | ACCESS ROAD, CRUSHED SURFACING MAT | 390.00 | CY  | 4,695 | 704 | 216 | 393 | 90 | 122 | 6,221 | 15.95 |

AC-008:1:8-6/- ACCESSION NUMBER: ACCESSION NUMBER: ACCESSION NUMBER:

ABOB ID: WINDA88 EQUIP ID: NAT97A

Currency in Dollars

CREW ID: NAT97A UBB ID: UP99EA

Fri 16 Apr 1999  
Eff. Date 10/01/99

U.S. Army Corps of Engineers  
PROJECT DEERC2: DEER CREEK RCC DAM & ROADS - Near Winchester, Northern Idaho  
RCC DAM FOR DEER CREEK. BUDGET ESTIMATE  
\*\* PROJECT INDIRECT SUMMARY - IND CODE \*\*

TIME 13:26:38  
SUMMARY PAGE 12

|                                                   | QUANTITY | UOM | DIRECT  | F-O-Head | Home OFC | Profit | TERO TAX | BOND    | TOTAL   | UNIT  |
|---------------------------------------------------|----------|-----|---------|----------|----------|--------|----------|---------|---------|-------|
| TOTAL ACCESS ROAD, PREP FOR SURFACING             | 1735.00  | LF  | 38,437  | 5,765    | 3,094    | 3,311  | 759      | 1,027   | 52,393  | 30.20 |
| AC-08.1.D-08- ACCESS ROAD, 4" BASE COURSE         |          |     |         |          |          |        |          |         |         |       |
| AC-08.1.D-08-.02BC Load, Haul & Place Base Course | 2320.00  | BCY | 9,792   | 1,469    | 788      | 843    | 193      | 262     | 13,348  | 5.75  |
| TOTAL ACCESS ROAD, 4" BASE COURSE                 | 2320.00  | SY  | 9,792   | 1,469    | 788      | 843    | 193      | 262     | 13,348  | 5.75  |
| AC-08.1.D-09- ACCESS ROAD, 2" TOP COURSE          |          |     |         |          |          |        |          |         |         |       |
| AC-08.1.D-09-.02BC Load, Haul & Place Top Course  | 1160.00  | BCY | 4,519   | 678      | 364      | 389    | 89       | 121     | 6,160   | 5.31  |
| TOTAL ACCESS ROAD, 2" TOP COURSE                  | 2320.00  | SY  | 4,519   | 678      | 364      | 389    | 89       | 121     | 6,160   | 2.66  |
| TOTAL NEW PERM-TO-TOP OF DAM A-ROAD(C)            | 1735.00  | LF  | 57,443  | 8,617    | 4,462    | 4,937  | 1,132    | 1,532   | 78,122  | 45.03 |
| TOTAL ROADS                                       | 45301    | LF  | 571,210 | 85,681   | 42,190   | 48,936 | 11,220   | 15,185  | 774,421 | 17.10 |
| TOTAL ROADS, RAILROADS, AND BRIDGES               | 14.23    | MI  | 571,210 | 85,681   | 42,190   | 48,936 | 11,220   | 15,185  | 774,421 | 54436 |
| TOTAL DEER CREEK RCC DAM & ROADS                  | 3313640  |     | 492,669 | 171,056  | 278,416  | 63,837 | 86,392   | 4406009 |         |       |

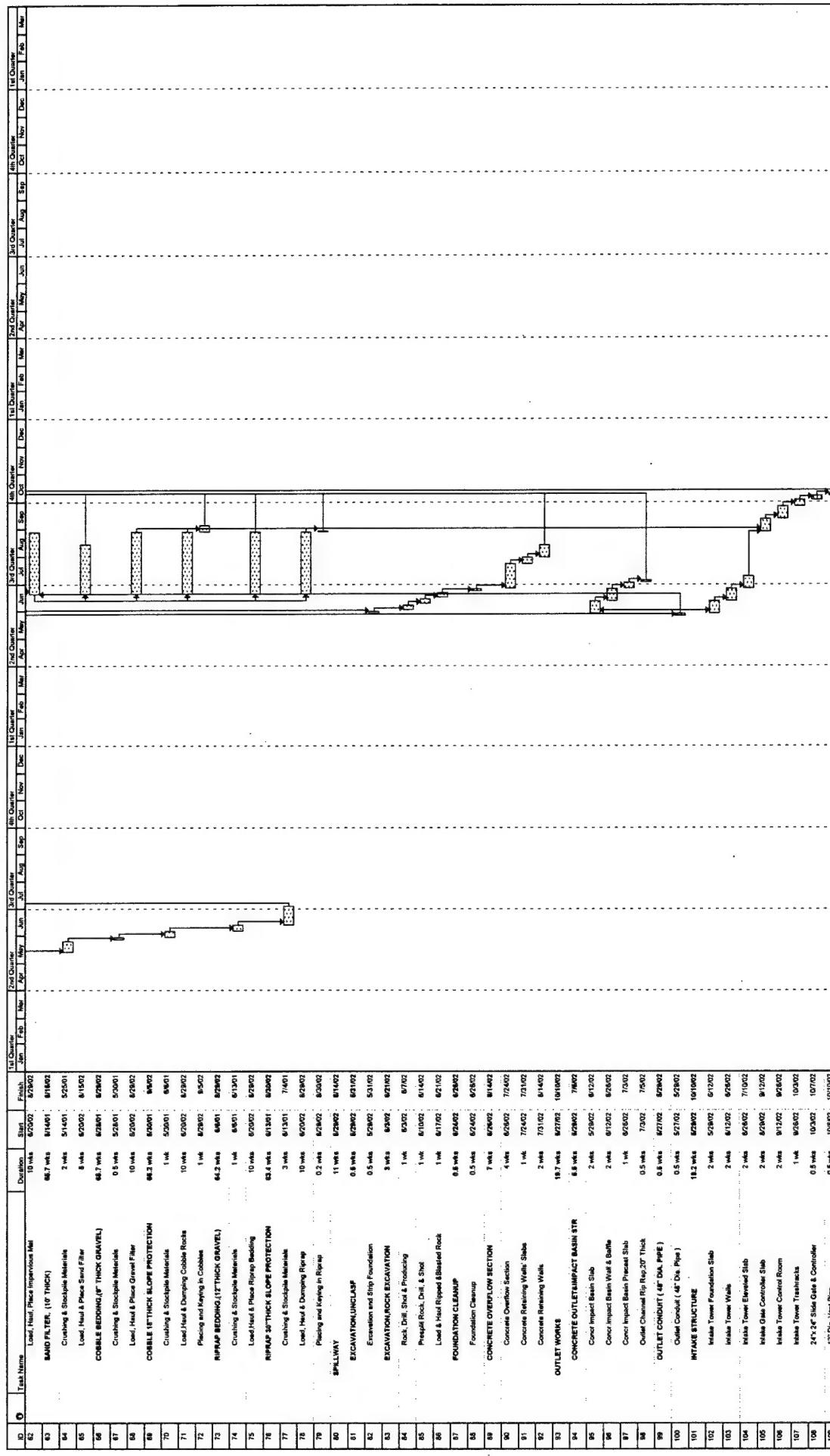
LABOR ID: NAT9A99 EQUIP ID: NAT97A

Currency in DOLLARS

CREW ID: NAT97A UFB ID: UP99EA

Construction Schedule for Embankment Dam Project

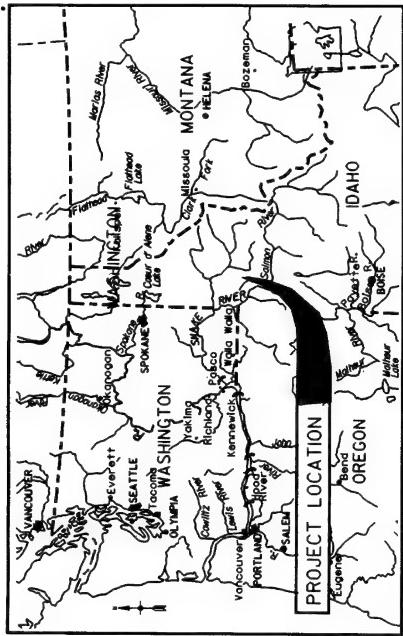
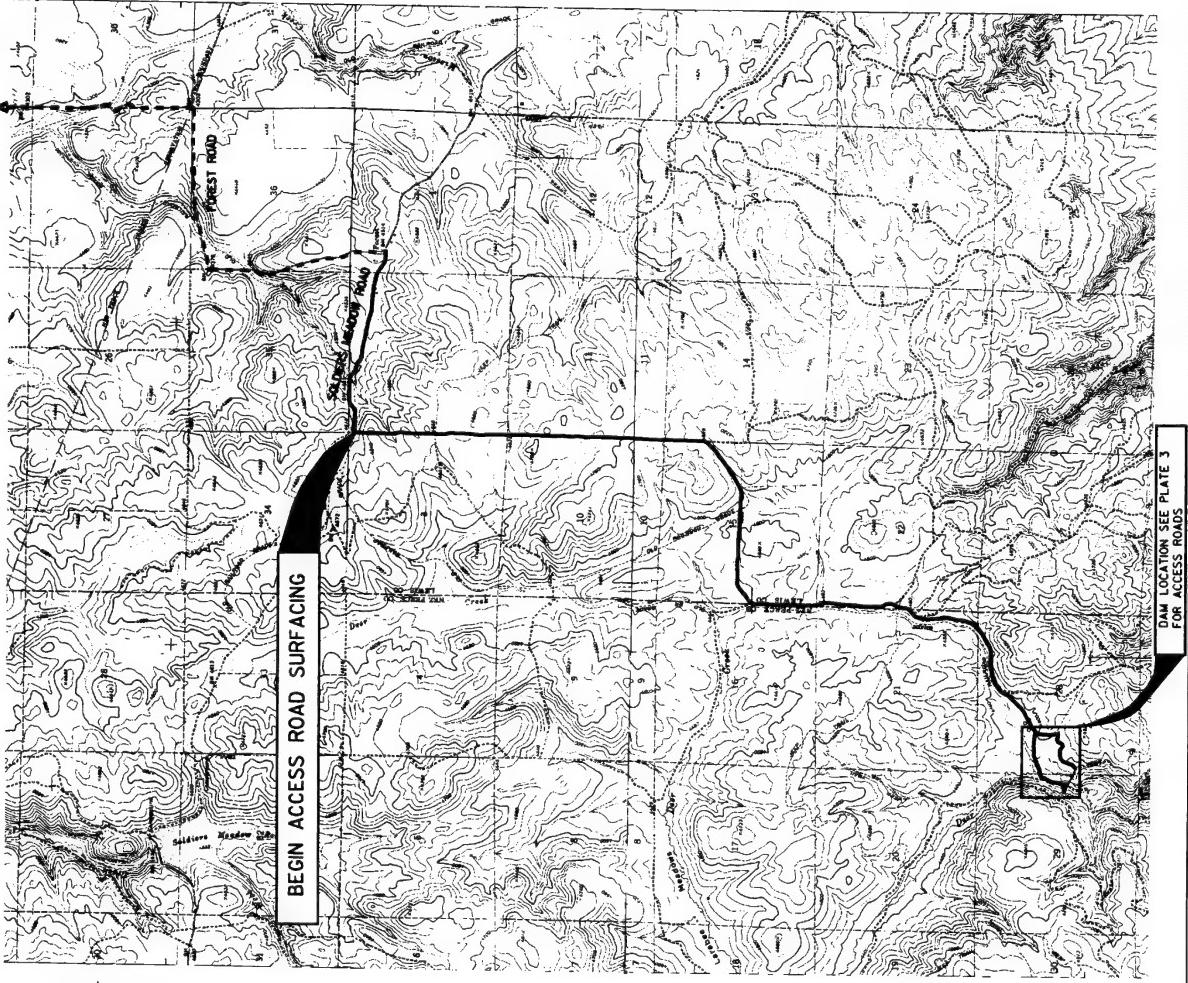
## Construction Schedule for Embankment Dam Project



## APPENDIX B

### Plates

1. Location and Vicinity Maps and Index to Drawings
2. Reservoir Map - Plan
3. Location Map - Access Roads and Borrow Areas
4. Dam Foundation - Plan Profile and Section
5. Earth Embankment Dam - Plan
6. Earth Embankment Dam - Profile Section and Detail
7. Earth Embankment Dam - Low Level Outlet Tower
8. Earth Embankment Dam Spillway - Plan and Section
9. Earth Embankment Dam Spillway - Longitudinal Section
10. Roller Compacted Concrete Dam Intake Structure - Elevations, Sections and Details
11. Roller Compacted Concrete Dam - Plan and Section
12. Roller Compacted Concrete Dam and Spillway - Profile and Section
13. Impact Basin - Plan and Sections



VICINITY MAP

SCALE IN MILES  
0 50 100 150

## INDEX TO DRAWINGS

PLATE NO. FILE NO. TITLE

|    |          |                                                                                    |
|----|----------|------------------------------------------------------------------------------------|
| 1  | NP0C01DN | LOCATION AND VICINITY MAPS AND INDEX TO DRAWINGS                                   |
| 2  | NP0C02DN | RESERVOIR MAP - PLAN                                                               |
| 3  | NP0C03DN | LOCATION MAP - ACCESS ROADS AND BARROW AREAS                                       |
| 4  | NP0C04DN | DAM FOUNDATION - PLAN PROFILE AND SECTION                                          |
| 5  | NP0C05DN | EARTH ENBANKMENT DAM - PLAN                                                        |
| 6  | NP0C06DN | EARTH ENBANKMENT DAM - PROFILE SECTION AND DETAIL                                  |
| 7  | NP0C07DN | EARTH ENBANKMENT DAM - LOW LEVEL OUTLET TOWER                                      |
| 8  | NP0C08DN | EARTH ENBANKMENT DAM SPILLWAY - PLAN AND SECTION                                   |
| 9  | NP0C09DN | EARTH ENBANKMENT DAM SPILLWAY - LONGITUDINAL SECTION                               |
| 10 | NP0C10DN | ROLLER COMPACTED CONCRETE DAM - INTAKE STRUCTURE - ELEVATIONS SECTIONS AND DETAILS |
| 11 | NP0C11DN | ROLLER COMPACTED CONCRETE DAM - PLAN AND SECTION                                   |
| 12 | NP0C12DN | ROLLER COMPACTED CONCRETE DAM - PROFILE AND SECTION                                |
| 13 | NP0C13DN | IMPACT BASIN - PLAN AND SECTIONS                                                   |

| PLATE NO. | FILE NO. | TITLE                                                                              |
|-----------|----------|------------------------------------------------------------------------------------|
| 1         | NP0C01DN | LOCATION AND VICINITY MAPS AND INDEX TO DRAWINGS                                   |
| 2         | NP0C02DN | RESERVOIR MAP - PLAN                                                               |
| 3         | NP0C03DN | LOCATION MAP - ACCESS ROADS AND BARROW AREAS                                       |
| 4         | NP0C04DN | DAM FOUNDATION - PLAN PROFILE AND SECTION                                          |
| 5         | NP0C05DN | EARTH ENBANKMENT DAM - PLAN                                                        |
| 6         | NP0C06DN | EARTH ENBANKMENT DAM - PROFILE SECTION AND DETAIL                                  |
| 7         | NP0C07DN | EARTH ENBANKMENT DAM - LOW LEVEL OUTLET TOWER                                      |
| 8         | NP0C08DN | EARTH ENBANKMENT DAM SPILLWAY - PLAN AND SECTION                                   |
| 9         | NP0C09DN | EARTH ENBANKMENT DAM SPILLWAY - LONGITUDINAL SECTION                               |
| 10        | NP0C10DN | ROLLER COMPACTED CONCRETE DAM - INTAKE STRUCTURE - ELEVATIONS SECTIONS AND DETAILS |
| 11        | NP0C11DN | ROLLER COMPACTED CONCRETE DAM - PLAN AND SECTION                                   |
| 12        | NP0C12DN | ROLLER COMPACTED CONCRETE DAM - PROFILE AND SECTION                                |
| 13        | NP0C13DN | IMPACT BASIN - PLAN AND SECTIONS                                                   |

U. S. ARMY ENGINEER DISTRICT  
WALLA WALLA, WASHINGTON

DEER CREEK DAM  
DAM ALTERNATIVES STUDY  
LOCATION AND VICINITY MAPS  
AND INDEX TO DRAWINGS

Computer Drafting  
A Division  
Deer Creek Dam

Scale as shown Inv. No. N

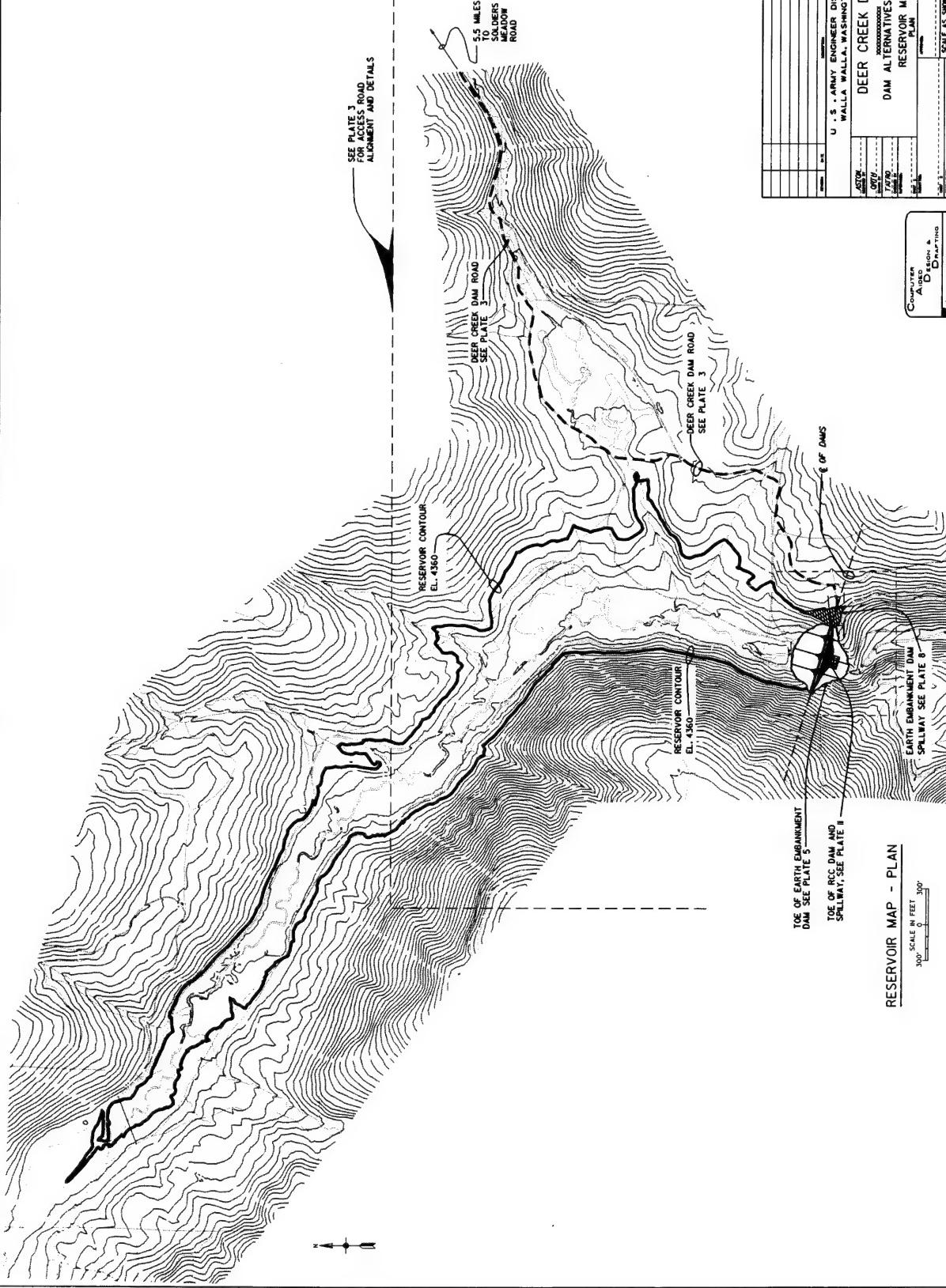
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14-Apr-1998 10:25

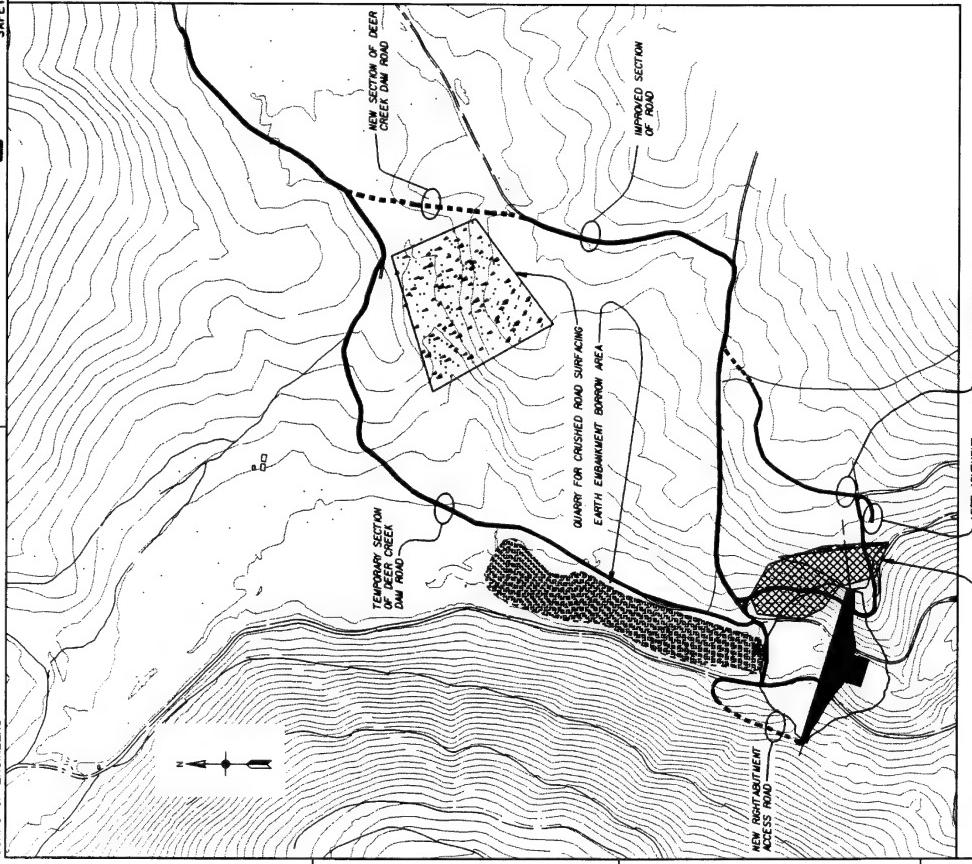
PLATE - 1

REFERENCE FILES ATTACHED  
YES NO  
LEVELS ON FOR CONTRACT DRAWS \$  
Scale 1:2000000  
14-Apr-1998 10:25

VICINITY MAP

PLATE - 1



LOCATION MAP - ACCESS ROADS AND BORROW AREAS

Scale: 1/4 mile = 200' 0"  
0 200' 200'



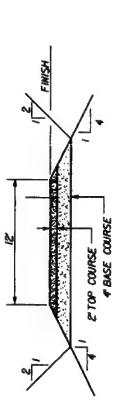
**VALUE ENGINEERING PAYS**

|                          |    |
|--------------------------|----|
| YES                      | NO |
| REFERENCE FILES ATTACHED |    |

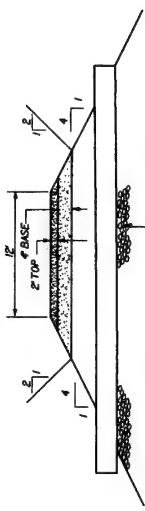
LEVELS SHOWN FOR CONTRACT DRILLS

SCALE / U-9-ODD-NPDCO3-dan

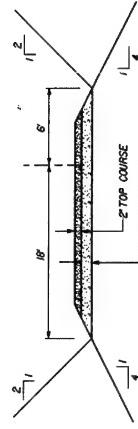
18-APR-1988 OSH4

TYPICAL ROAD SECTION

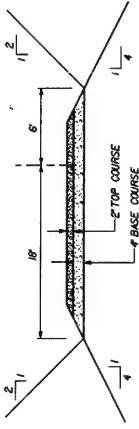
N.T.S.

TYPICAL CULVERT SECTION

N.T.S.

RIGHT PULL OUT SECTION

N.T.S.

LEFT PULL OUT SECTION

N.T.S.

LEGEND

- ◆ CHARRY FOR CRUSHED ROAD SURFACE
- EARTH EMBANKMENT BORROW AREA
- ◆ CHARRY FOR RCC COURSE AGGREGATE OR EARTH EMBANKMENT ROCK
- IMPROVED SECTION OF ROAD
- • • • NEW SECTION OF DEER CREEK DAM ROAD

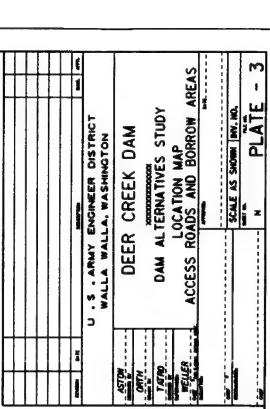
CHARRY FOR CRUSHED ROAD SURFACE

EARTH EMBANKMENT BORROW AREA

CHARRY FOR RCC COURSE AGGREGATE OR EARTH EMBANKMENT ROCK

IMPROVED SECTION OF ROAD

• • • • NEW SECTION OF DEER CREEK DAM ROAD



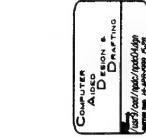
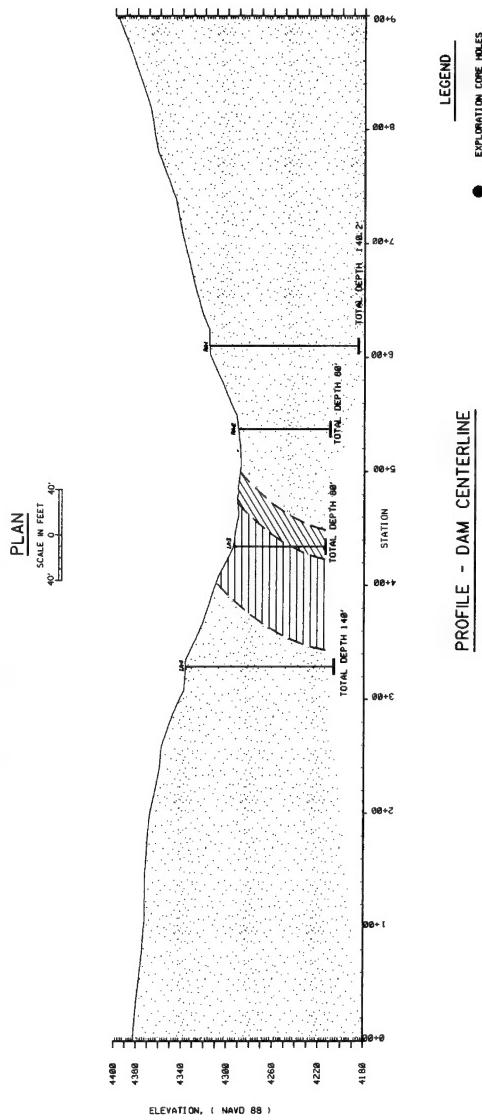
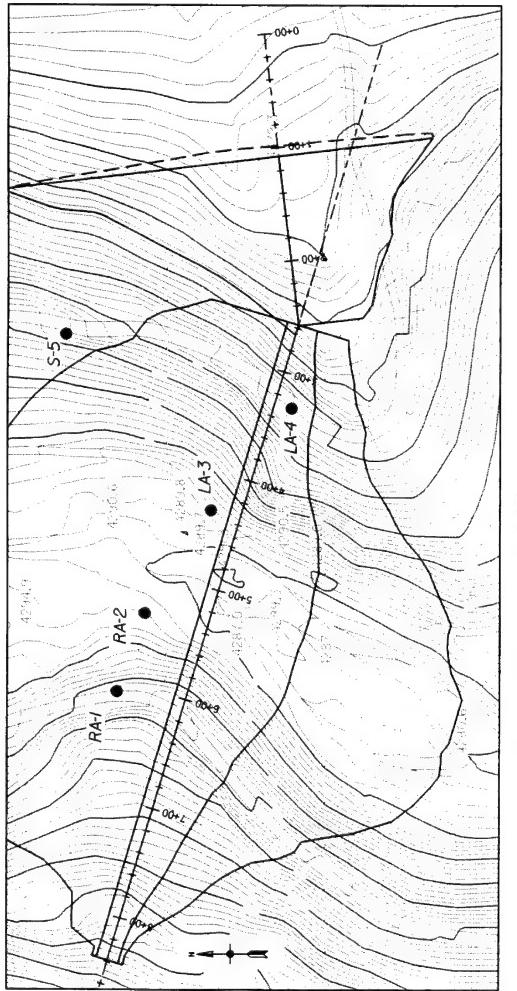
DEER CREEK DAM  
DAM ALTERNATIVES STUDY  
LOCATION MAP - ACCESS ROADS AND BORROW AREAS

Computer Aided Design & Drafting  
Map and Site Plan by Soddy Associates

Scale as shown in drawing

N PLATE - 3

PLATE - 3



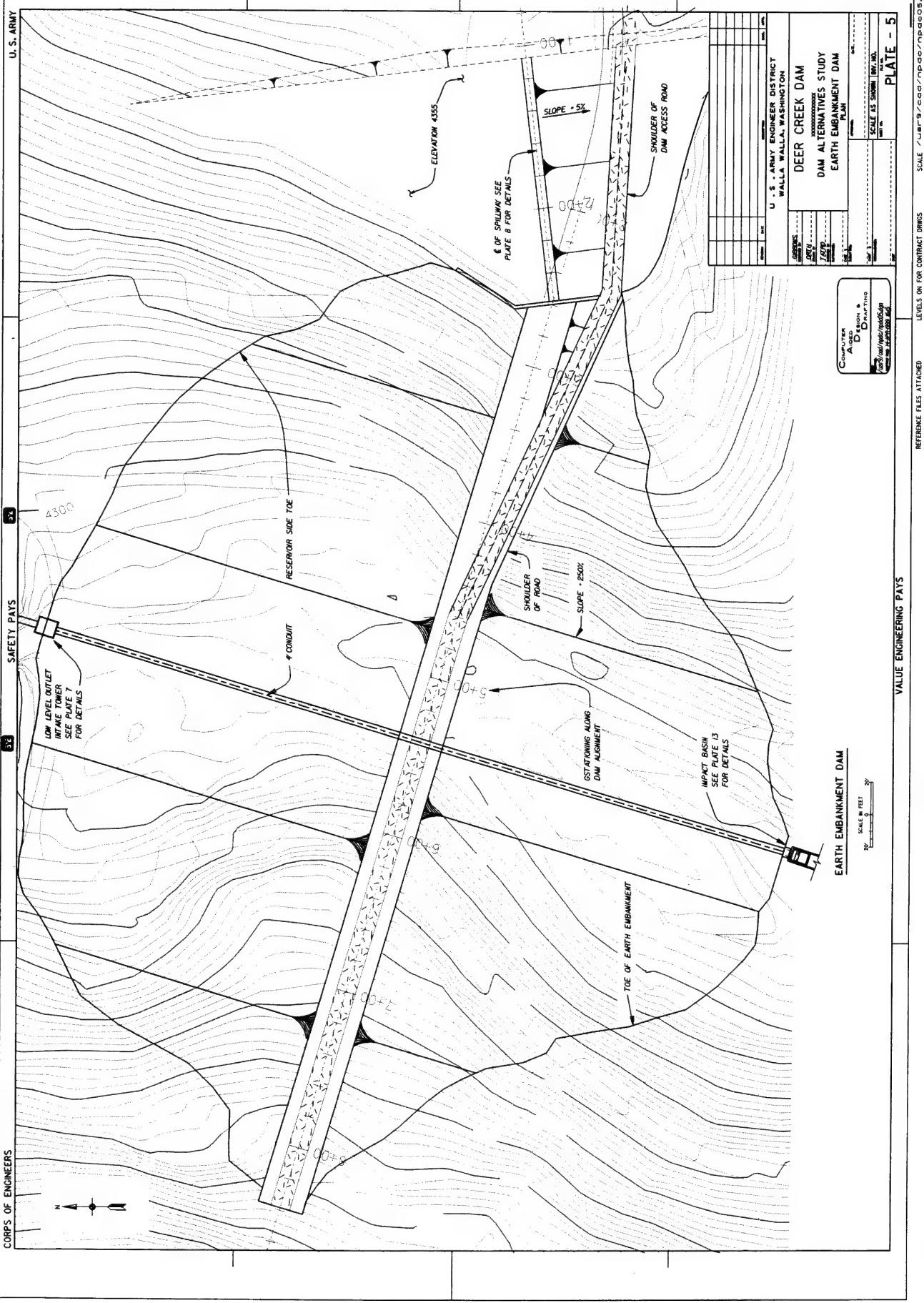
VALUE ENGINEERING PAYS

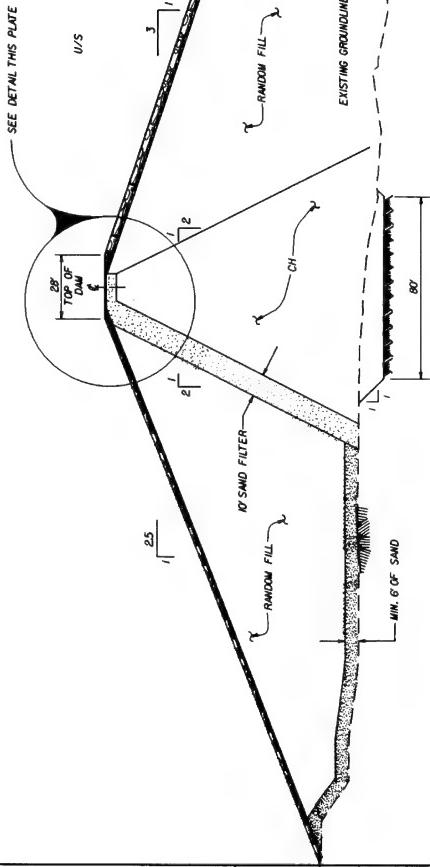
REFERENCE FILES ATTACHED  
YES NO  
LEVELS ON FOR CONTRACT DRILLS  
\$  
PLATE = 4  
N  
SCALE 1/4" = 100'-0" 10' 12" 18' 12" 24'  
\$  
PAGE 4 OF 4

CORPS OF ENGINEERS

FEET & DAVE

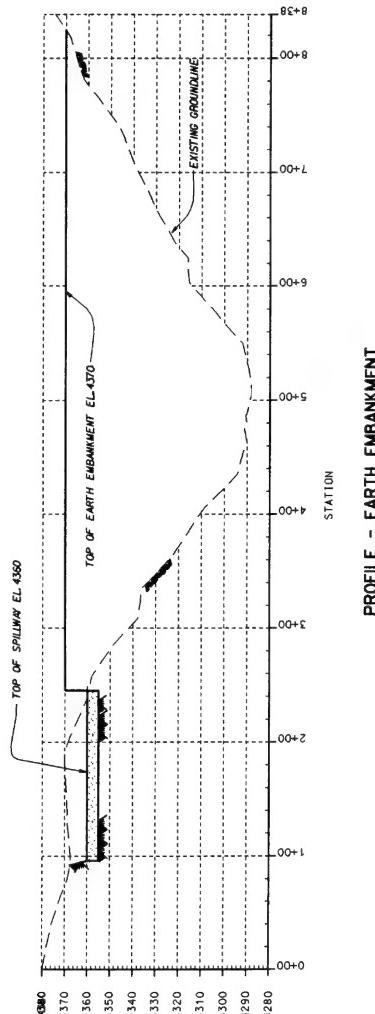
116 ADV





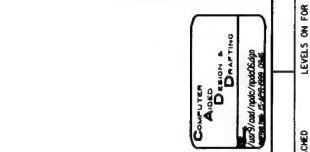
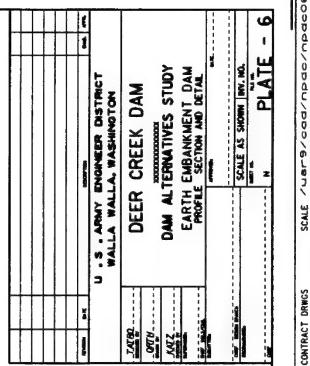
SECTION - EARTH EMBANKMENT (TYP.)

ELEVATION, FT. (NAVD 88)



PROFILE - EARTH EMBANKMENT

ELEVATION, FT. (NAVD 88)



VALUE ENGINEERING PAYS

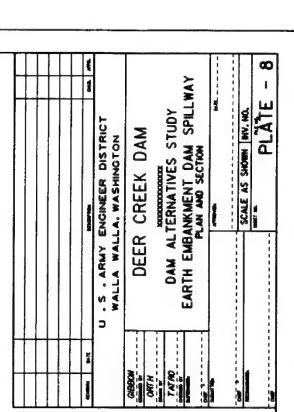
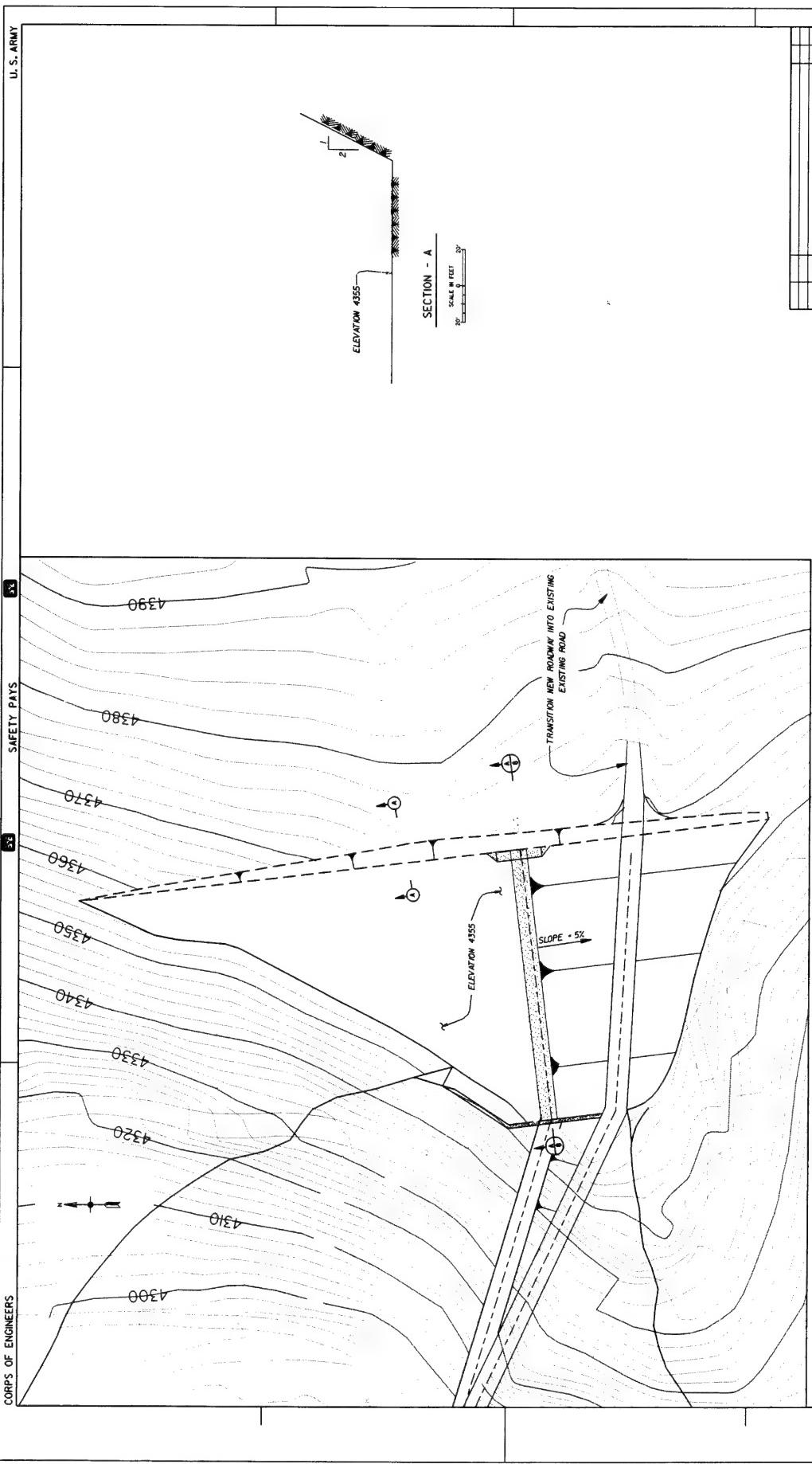
REFERENCE FILES ATTACHED

LEVELS ON FOR CONTRACT DRILLS

\$

SCALE / U.S. ARMY ENGINEER DISTRICT / DEER CREEK DAM / WALLA WALLA, WASHINGTON / 10-A-4-999 Ordn





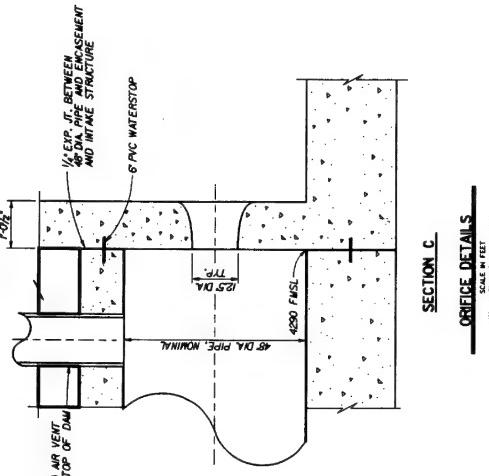
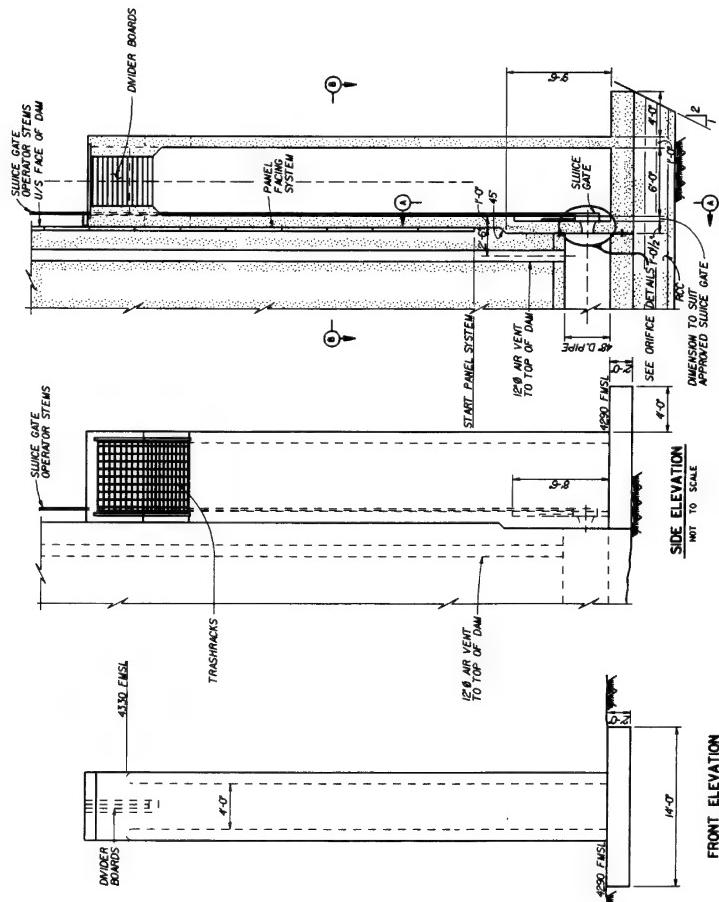
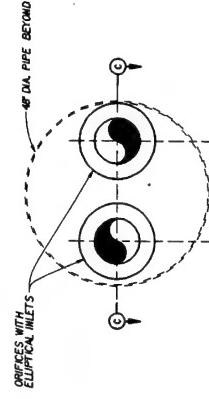
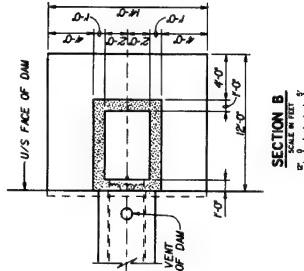
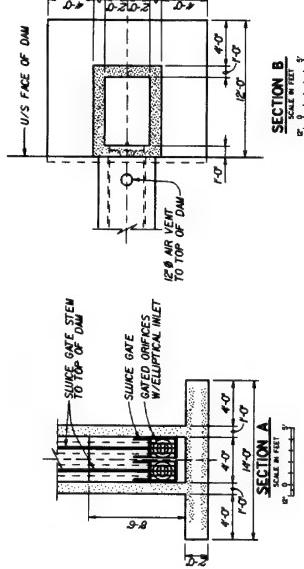
LEVELS ON FOR CONTRACT DRAWS  
YES NO  
REFERENCE FILES ATTACHED  
\$  
SCALE 1:4800 / COORDINATES  
14-APR-99 13139

SECTION A-A

20' 0" 5' 0"

VALUE ENGINEERING PAYS





SECTION C  
ORIFICE DETAILS

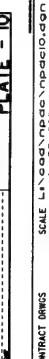
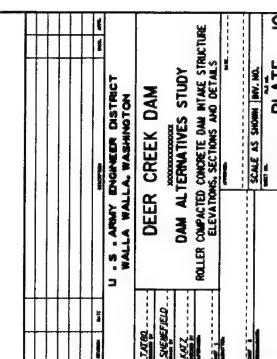
SCALE IN FEET

1'

2'

3'

4'



SCALE 1:1000 DRAWN AND DESIGNED

14 APR 1989

10



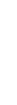
SCALE AS SHOWN IN FIG.

10



SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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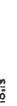
SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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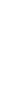
SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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SCALE AS SHOWN IN FIG.

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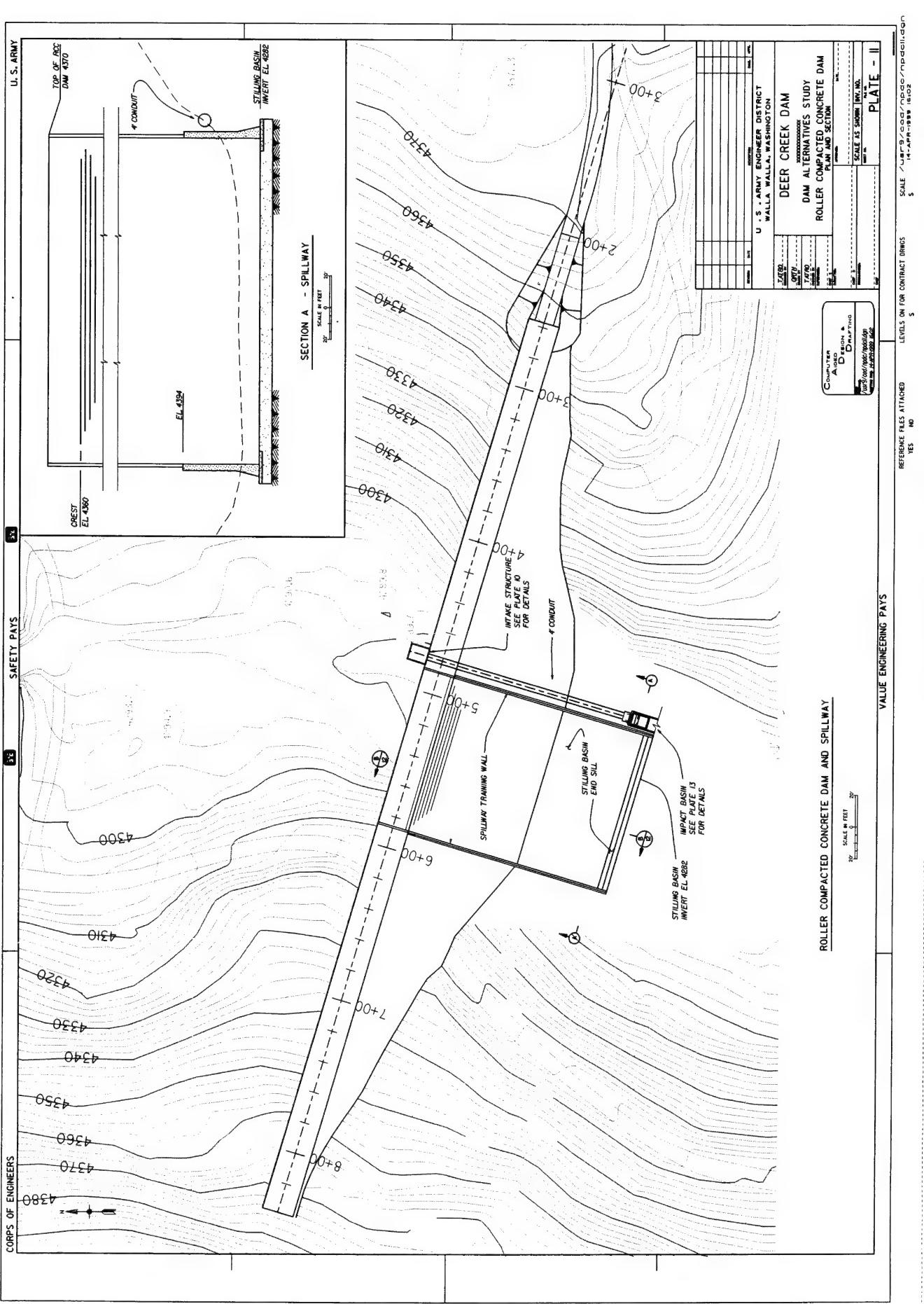


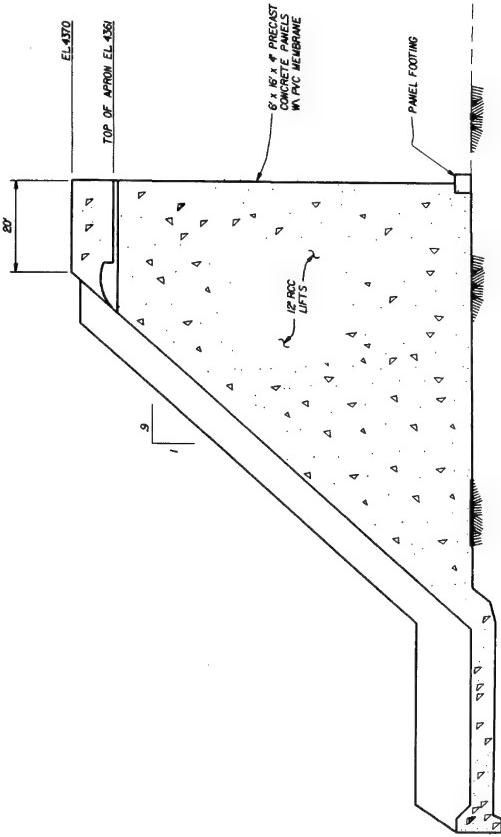
SCALE AS SHOWN IN FIG.

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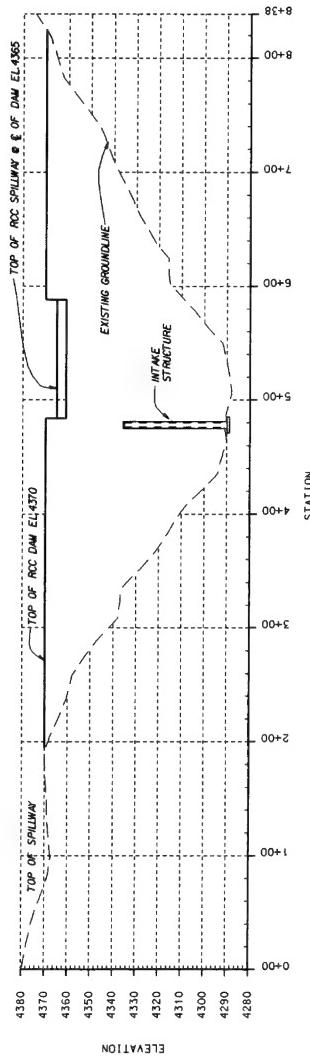
SCALE AS SHOWN IN FIG.



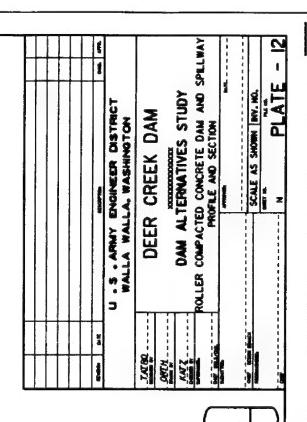


SECTION B - ROLLER COMPACTED CONCRETE DAM

12 SCALE 1' 0" FEET



UPSTREAM PROFILE - ROLLER COMPACTED CONCRETE DAM



VALUE ENGINEERING PAYS

REFERENCE FILE ATTACHED

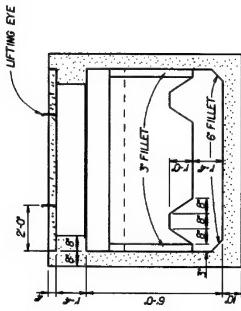
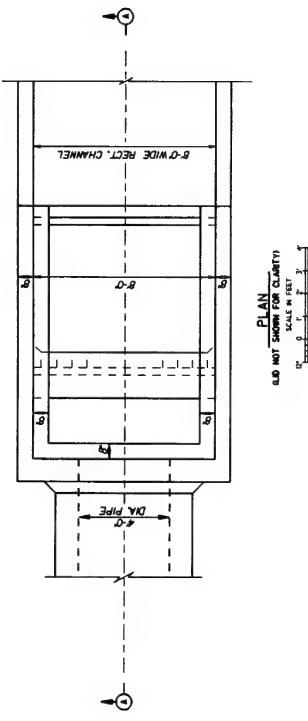
LEVELS ON FOR CONTRACT WORKS

\$

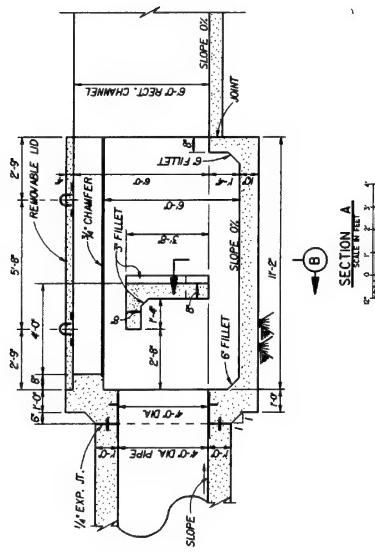
SCALE / U.S. 1'-0" / CAD / NPD / 12.DWG

15-APR-1999

0804



SECTION B



SECTION A

VALUE ENGINEERING PAYS

REFERENCE FILES ATTACHED LEVELS ON FOR CONTRACT DRNGS

SCALE / מטרת odd/nada/nada/odd/nada/odd

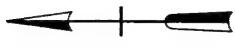
[panda3d.org](http://www.panda3d.org)

C

## **APPENDIX C**

### **Maps**

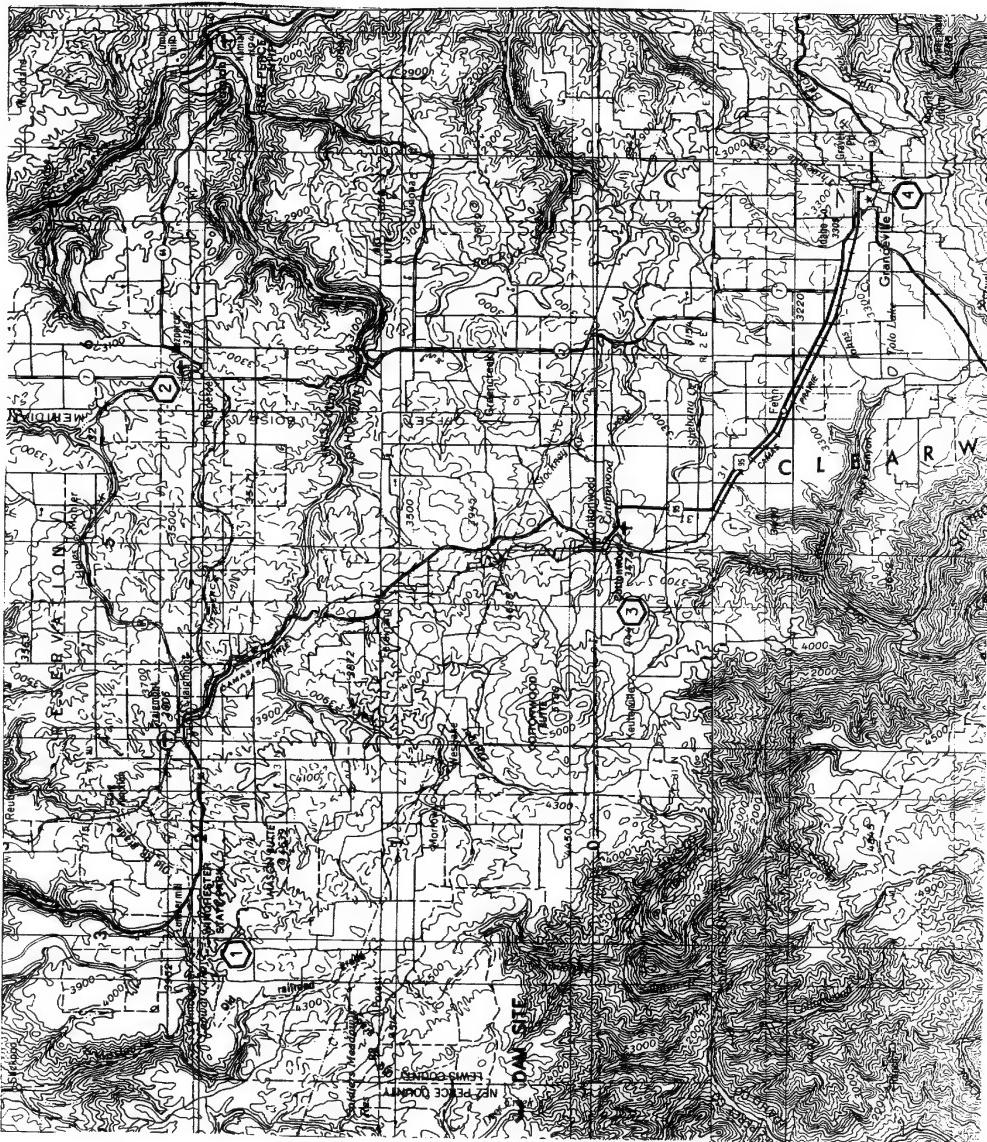
- 1. Gage Locations**
- 2. Drainage Basin Map**
- 3. Inundation Map**



## NOTE:

THIS MAPPING IS TAKEN FROM UNITED STATES  
GEOLOGICAL SURVEY MAPS GRANGEVILLE, IDAHO;  
WASHINGTON, 1955, REVISED 1979 AND PULLMAN,  
WASHINGTON; IDAHO, 1955, REVISED 1974.

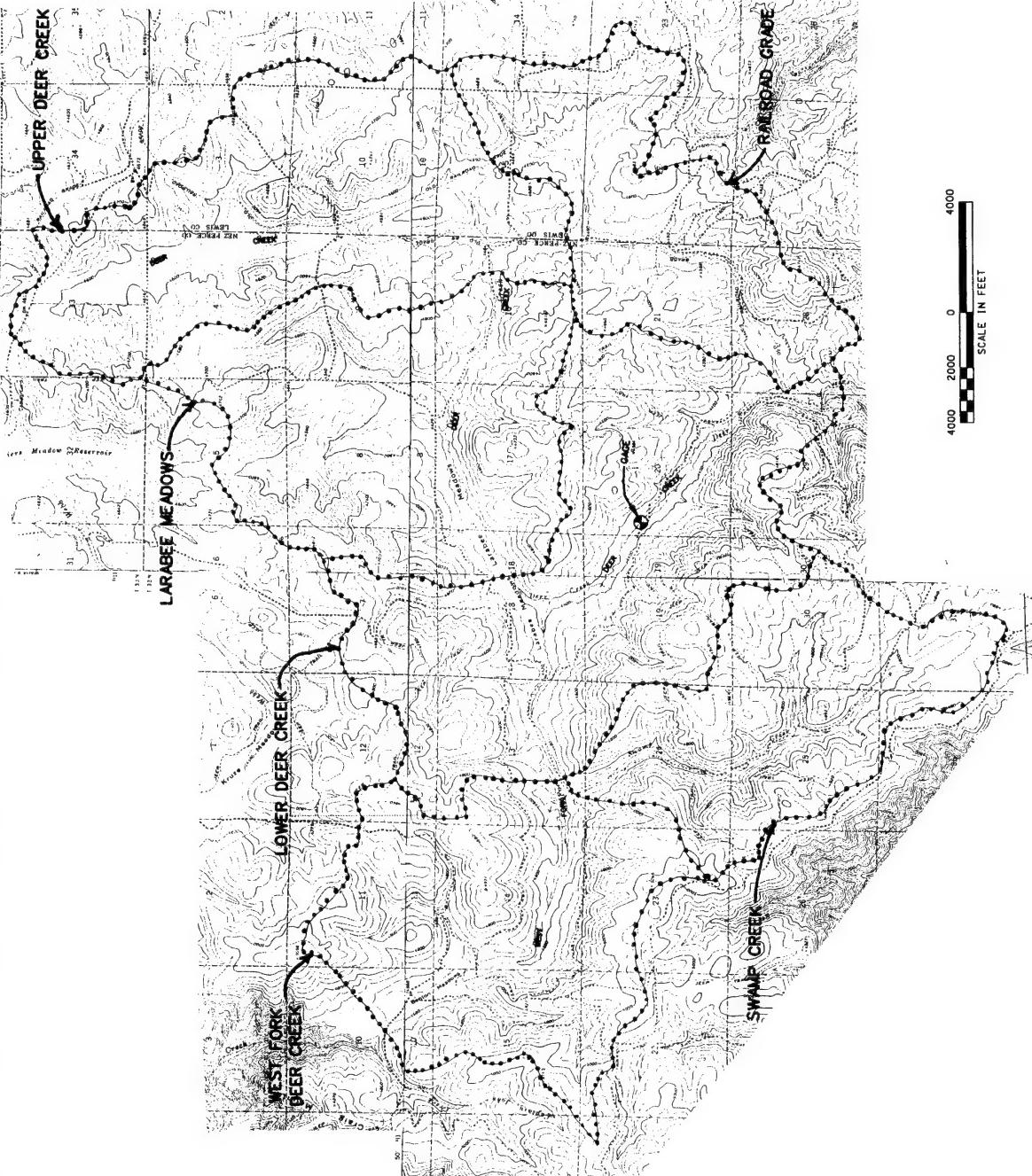
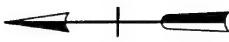
| LEGEND |                 |
|--------|-----------------|
| NUMBER | DESCRIPTION     |
| 1      | WINCHESTER      |
| 2      | NEPERCE         |
| 3      | COTTONWOOD 2 NW |
| 4      | GRANGEVILLE     |
| 1      | GAGE LOCATION   |



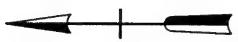
| DATE                                                      | REVISION        | BY                                                           |
|-----------------------------------------------------------|-----------------|--------------------------------------------------------------|
| 040614                                                    | B               | U. S. ARMY ENGINEER DISTRICT<br>WALLA WALLA HYDROLOGY BRANCH |
| <b>SALMON RIVER BASIN</b><br>DEER CREEK DAM AND RESERVOIR |                 |                                                              |
| GAGE LOCATIONS                                            |                 |                                                              |
| DESIGNED<br>HEITSMAN                                      | DRAWN<br>MAXSON | DATE<br>MARCH 1999                                           |

5  
0  
SCALE IN MILES

MAP 1

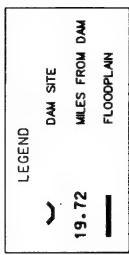
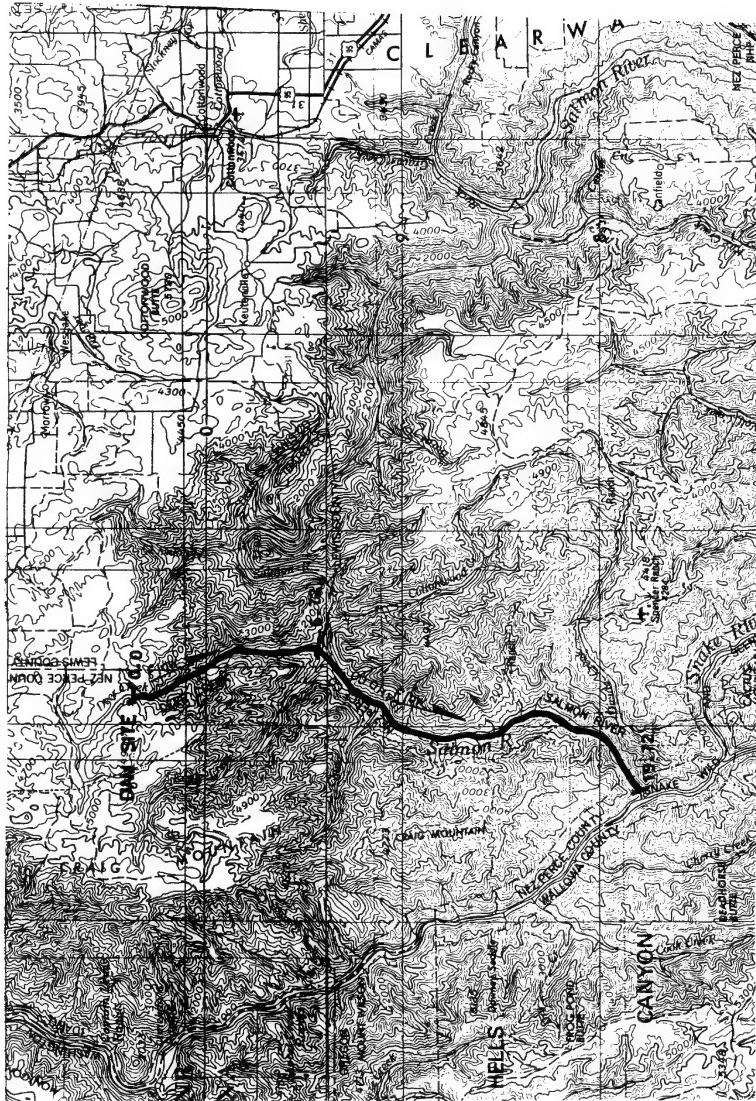


|                                                                |                    |
|----------------------------------------------------------------|--------------------|
| DATE                                                           | REVISION           |
| 87                                                             |                    |
| SALMON RIVER BASIN<br>DEER CREEK DAM AND RESERVOIR             |                    |
| DRAINAGE<br>BASIN MAP                                          |                    |
| U. S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |                    |
| DESIGNED<br>A00615                                             | DRAWN<br>HETSTUMAN |
| MAILED<br>MARCH 1959                                           | MAP 2              |

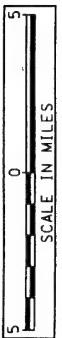


## NOTES:

1. THIS MAPPING IS TAKEN FROM UNITED STATES GEOLOGICAL SURVEY MAPS GRANGEVILLE, IDAHO; WASHINGTON, 1955, REVISED 1979 AND PULLMAN, WASHINGTON; IDAHO, 1955, REVISED 1974.
2. THE LOCATIONS OF THREE OF THE TWENTY-SEVEN CROSS SECTIONS USED IN THE DAM BREAK MODEL ARE SHOWN ON THIS MAP. THE CROSS SECTIONS ARE LOCATED AT THE DAM, 6.72 MILES AND 19.72 MILES DOWNSTREAM FROM THE DAM, RESPECTIVELY. CROSS SECTION GEOMETRY WAS ESTIMATED FROM USGS 7.5 MINUTE QUADRANGLE MAPS; CONTOUR INTERVAL FORTY FEET. THE MAXIMUM STAGE OF THE DAM BREAK FLOOD WAVE IS SLIGHTLY IN EXCESS OF FORTY FEET AT EACH LOCATION; THE ASSOCIATED FLOOD VARYES FROM APPROXIMATELY 200 TO 300 FEET. THE NARROW STEEP VALLEYS OF DEER CREEK AND THE SALMON RIVER IN THE REACH SHOWN PRECLUDE SHOWING A DETAILED INUNDATION MAP ON 7.5 MINUTE QUADRANGLE MAPS. THEREFORE, 1:250,000 SCALE MAPS ARE USED TO SHOW CROSS SECTION LOCATION ONLY.



|                                                               |                             |
|---------------------------------------------------------------|-----------------------------|
| 15 APR 59                                                     | ADDED LEGEND AND FLOODPLAIN |
| DATE                                                          | REVISION                    |
| JCA                                                           |                             |
| SALMON RIVER BASIN                                            |                             |
| DEER CREEK DAM AND RESERVOIR                                  |                             |
| INUNDATION MAP                                                |                             |
| U.S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |                             |
| A00616                                                        | DRAWN                       |
| HEITSTUMAN                                                    | MASSON                      |
| MARCH 1989                                                    |                             |



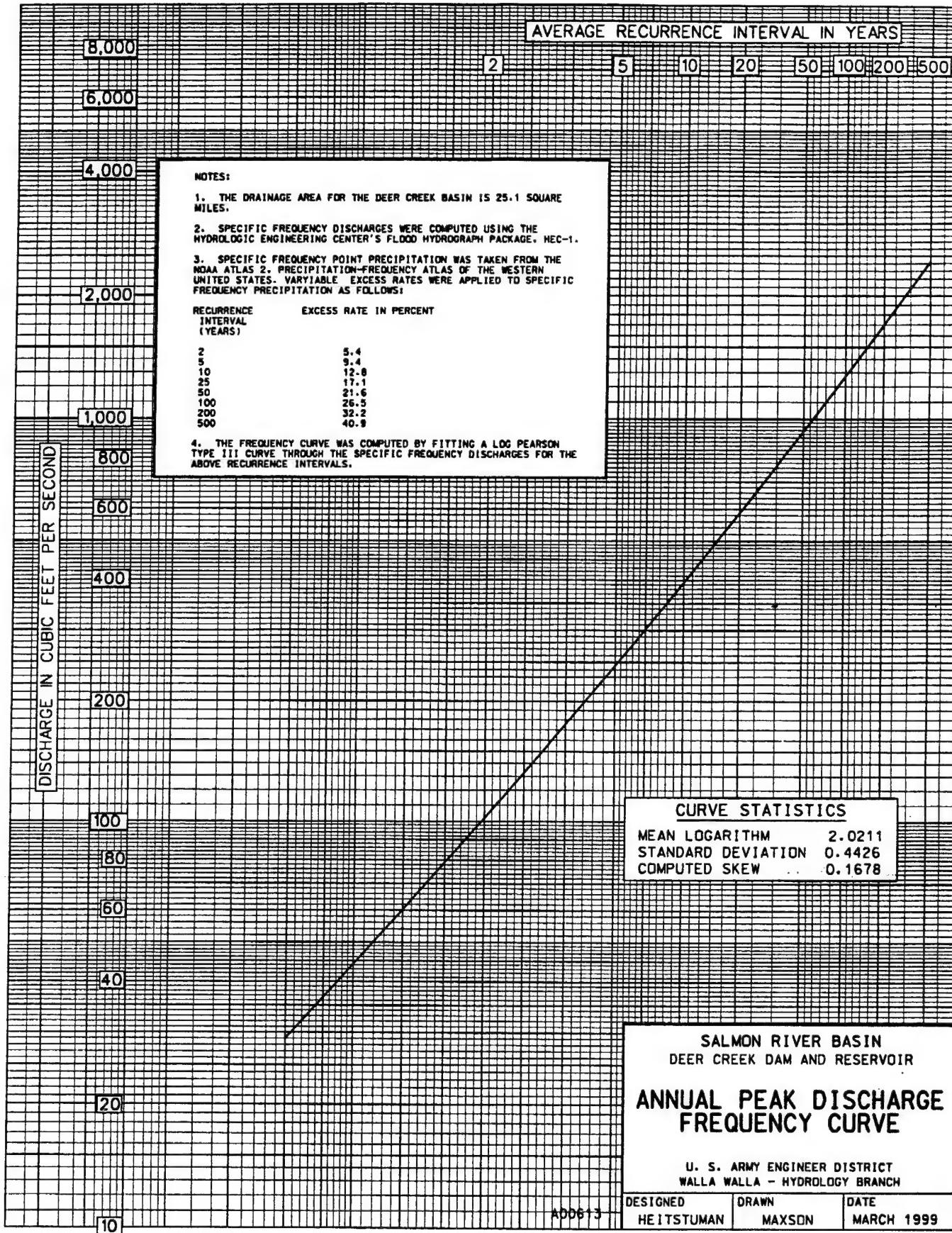
A00616  
HEITSTUMAN  
DRAWN  
MASSON  
MARCH 1989

MAP 3

## APPENDIX D

### Charts

1. Annual Peak Discharge, Frequency Curve
2. 30 Minute Unit Hydrograph - West Fork Deer Creek
3. 30 Minute Unit Hydrograph - Larabee Meadows
4. 30 Minute Unit Hydrograph - Upper Deer Creek
5. 30 Minute Unit Hydrograph - Swamp Creek
6. 30 Minute Unit Hydrograph - Lower Deer Creek
7. 30 Minute Unit Hydrograph - Rail Road Grade
8. Probable Maximum Flood (PMF) and One Half PMF
9. Storage vs. Elevation Curve
10. Drawdown Curve
11. Flow Duration Curve April through July
12. Dam Break Analysis Cross Section at Dam Site (Cross Section 0.00)
13. Dam Break Analysis Cross Section at Mouth of Deer Creek (Cross Section 6.72)
14. Dam Break Analysis Cross Section at Mouth of Salmon River (Cross Section 19.72)
15. Tailwater Rating Curve
16. RCC Dam
17. Embankment Dam



99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2

EXCEEDANCE PROBABILITY IN PERCENT

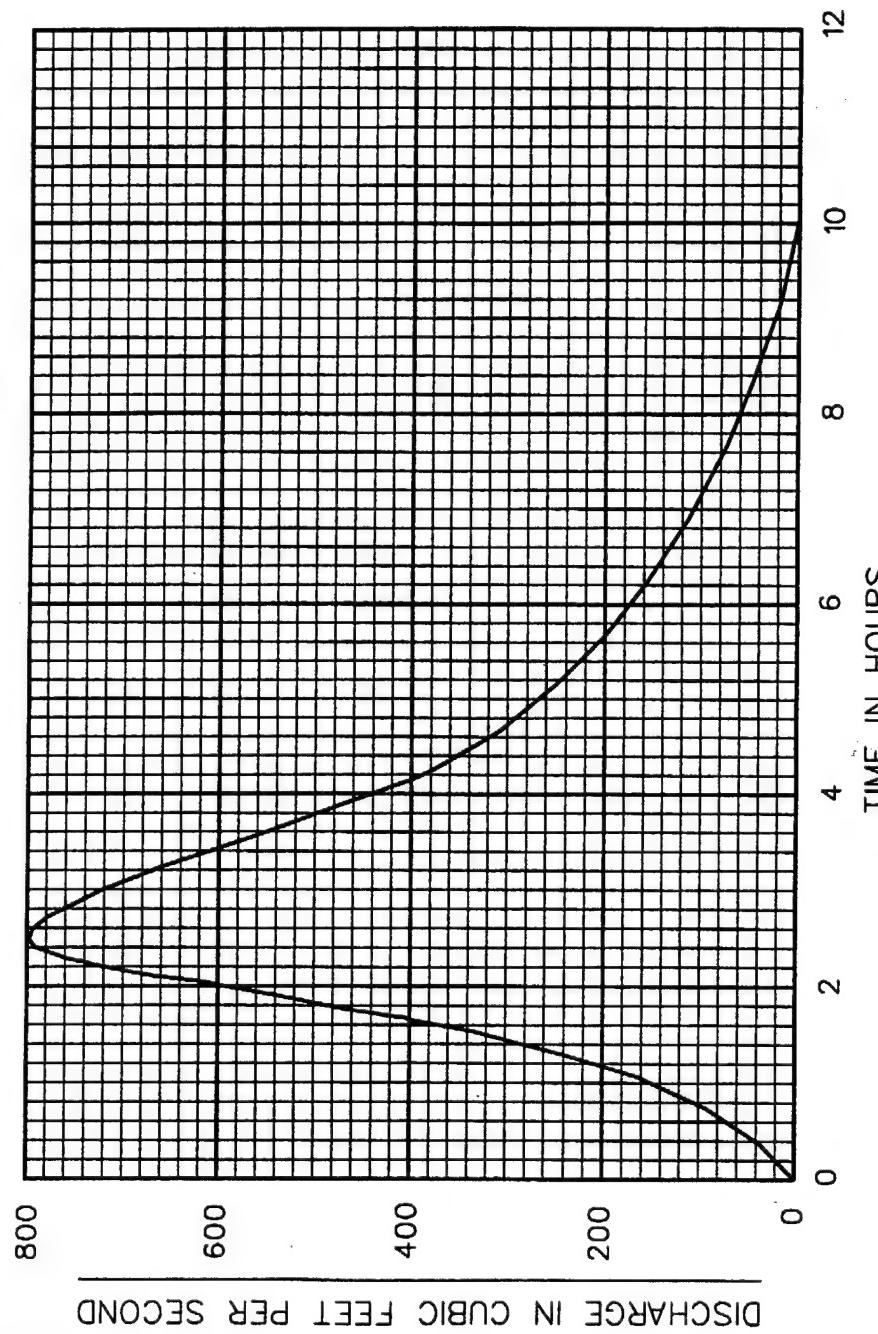
CHART 1

| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |
|      |          |    |

**SALMON RIVER BASIN**  
DEER CREEK DAM AND RESERVOIR  
WEST FORK DEER CREEK

**30 MINUTE UNIT**  
**HYDROGRAPH**

U. S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH



UNIT HYDROGRAPH PARAMETERS

$DA = 3.96$  SQUARE MILES  
 $L = 2.42$  MILES  
 $L_{ca} = 1.35$  MILES  
 $C_t = 1.55$   
 $T_{pr} = 2.23$   
 $Q_p = 798$  cfs

CHART 2

A00599

|            |        |            |
|------------|--------|------------|
| DESIGNED   | DRAWN  | DATE       |
| HEITSTUMAN | MAXSON | MARCH 1999 |

UNIT HYDROGRAPH PARAMETERS

DA = 4.43 SQUARE MILES  
L = 3.38 MILES  
Lca = 1.57 MILES  
Ct = 1.38  
Tpr = 2.30  
Qp = 866 CFS

| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |
|      |          |    |

SALMON RIVER BASIN  
DEER CREEK DAM AND RESERVOIR  
LARABEE MEADOWS

# 30 MINUTE UNIT HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH  
DESIGNED DRAWN DATE  
HEITSTUMAN MAXSON MARCH 1989

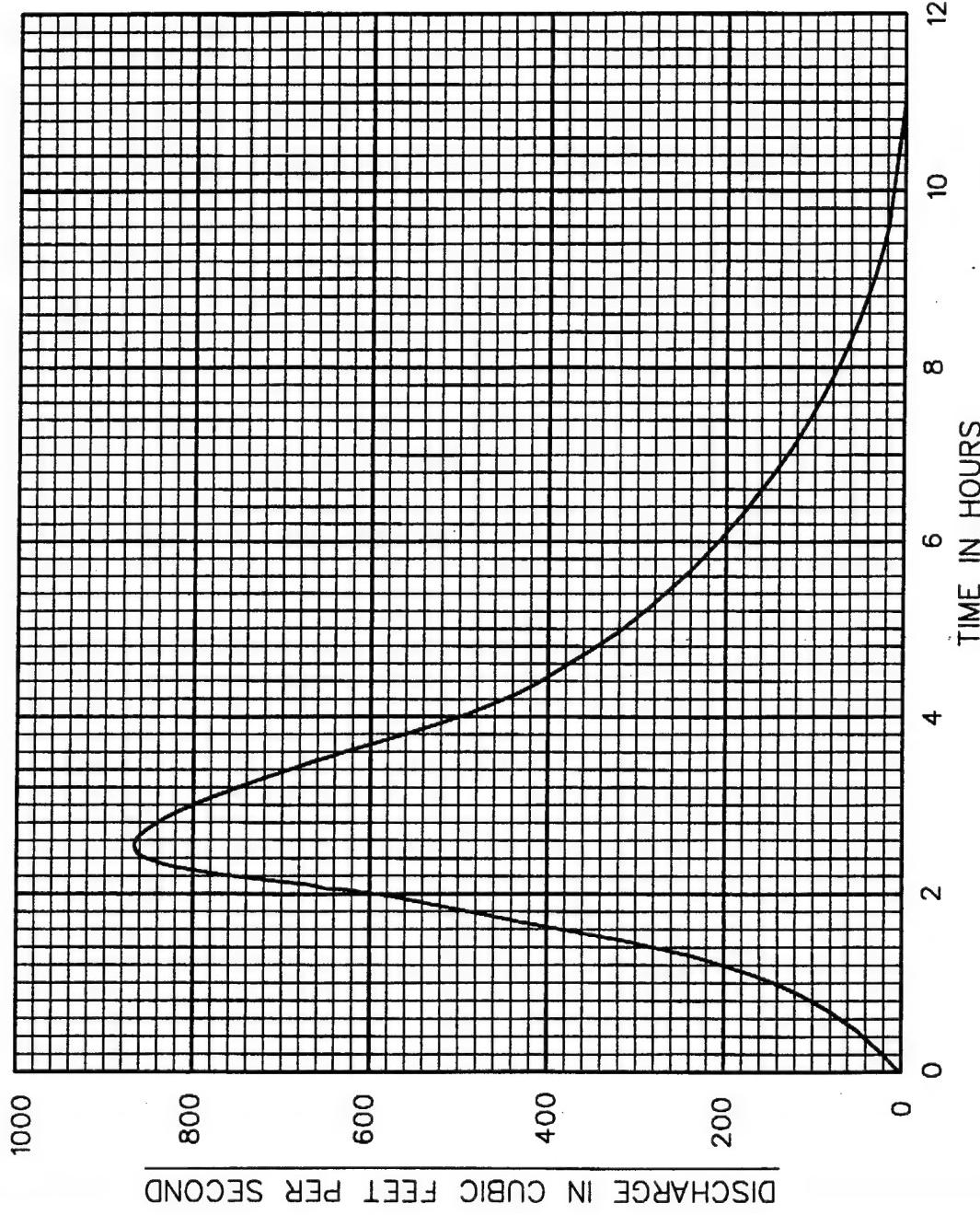
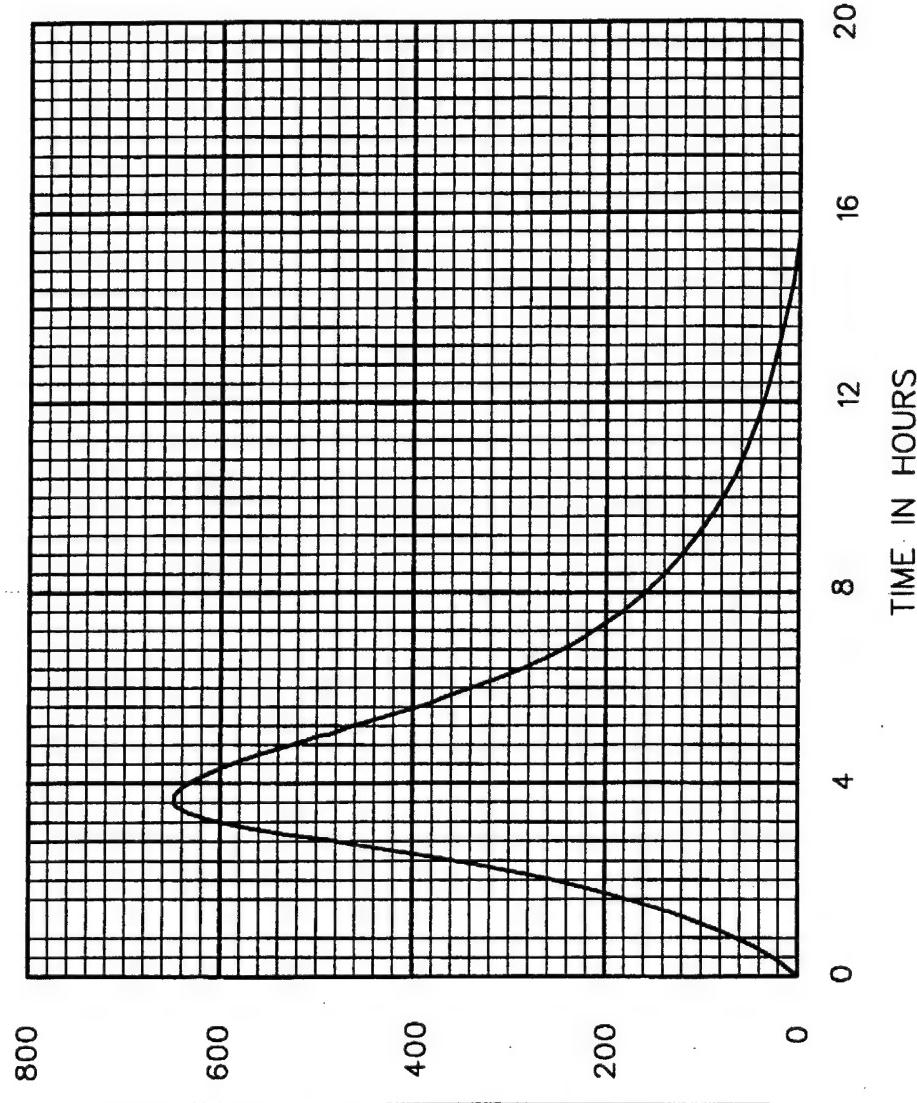


CHART 3

UNIT HYDROGRAPH PARAMETERS

DA = 4.77 SQUARE MILES  
L = 3.45 MILES  
Lca = 1.48 MILES  
Ct = 2.05  
Tpr = 3.31  
Qp = 648 CFS



**30 MINUTE UNIT HYDROGRAPH**

**SAFON RIVER BASIN**  
DEER CREEK DAM AND RESERVOIR  
UPPER DEER CREEK

U.S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH  
DESIGNED DRAWN DATE  
HEITSTUMAN MAXSON MARCH 1999

|      |          |    |
|------|----------|----|
| DATE | REVISION | BY |
|      |          |    |
|      |          |    |
|      |          |    |

**30 MINUTE UNIT  
HYDROGRAPH**

U.S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH  
DESIGNED DRAWN DATE  
HEITSTUMMAN MAXSON MARCH 1999

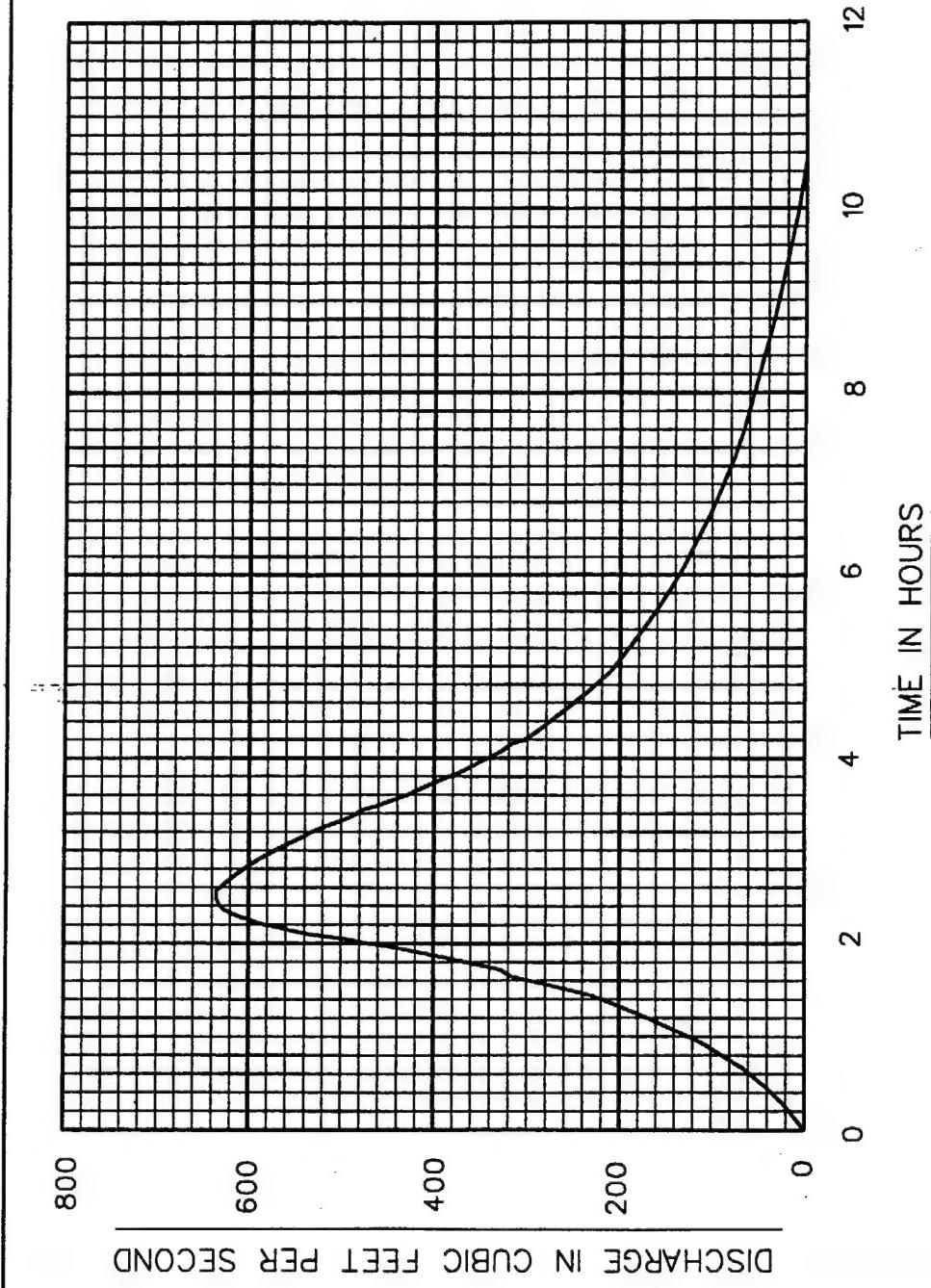


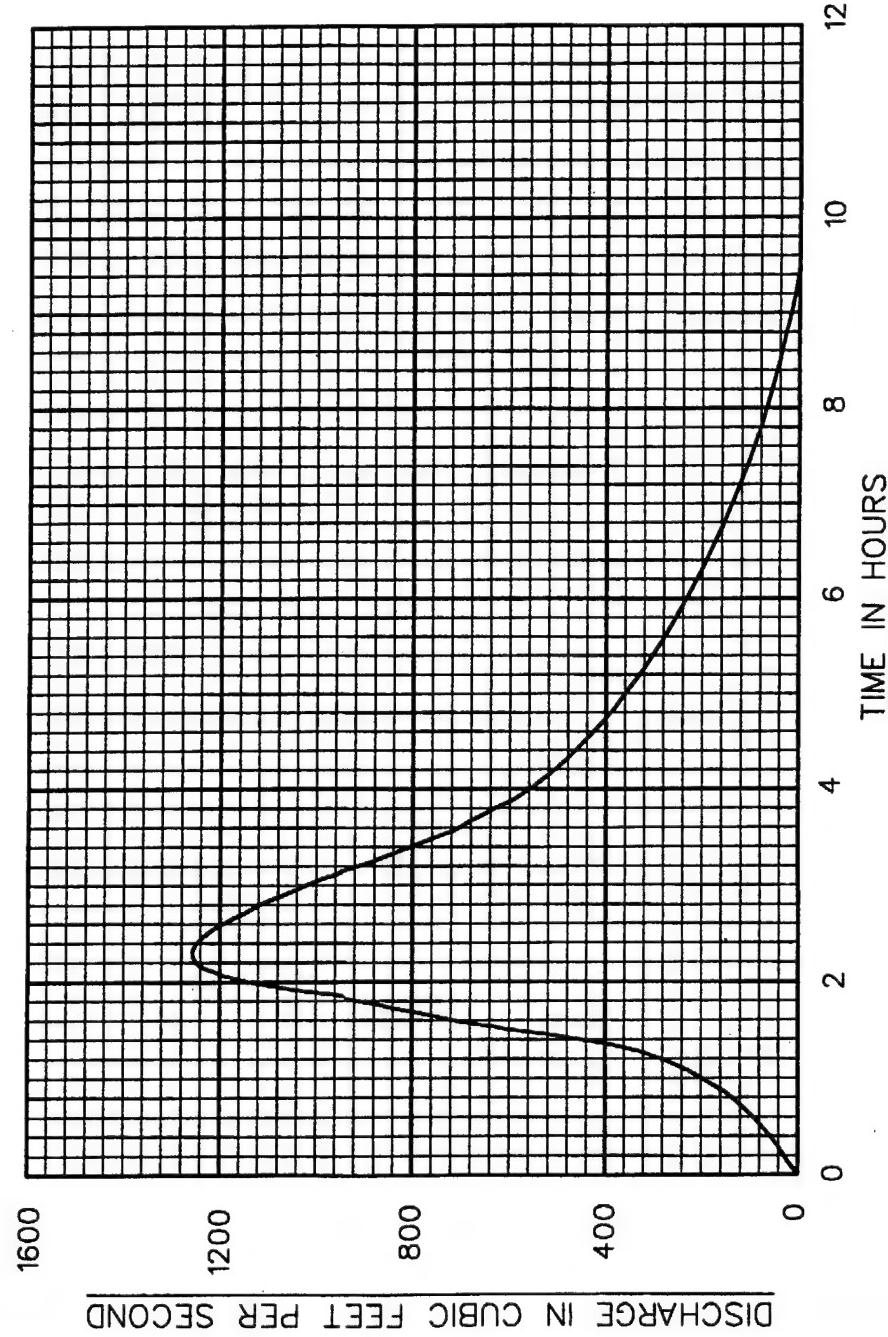
CHART 5

**SALMON RIVER BASIN**  
**DEER CREEK DAM AND RESERVOIR**  
**LOWER DEER CREEK**

**30 MINUTE UNIT**  
**HYDROGRAPH**

|                                                               |        |            |
|---------------------------------------------------------------|--------|------------|
| U.S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |        |            |
| DESIGNED                                                      | DRAWN  | DATE       |
| HEITSTUMAN                                                    | MAXSON | MARCH 1999 |

A00603



UNIT HYDROGRAPH PARAMETERS

DA - 5.71 SQUARE MILES  
 L - 4.22 MILES  
 L<sub>ca</sub> - 2.25 MILES  
 Ct - 1.02  
 T<sub>pr</sub> - 2.04  
 Q<sub>p</sub> - 1260 CFS

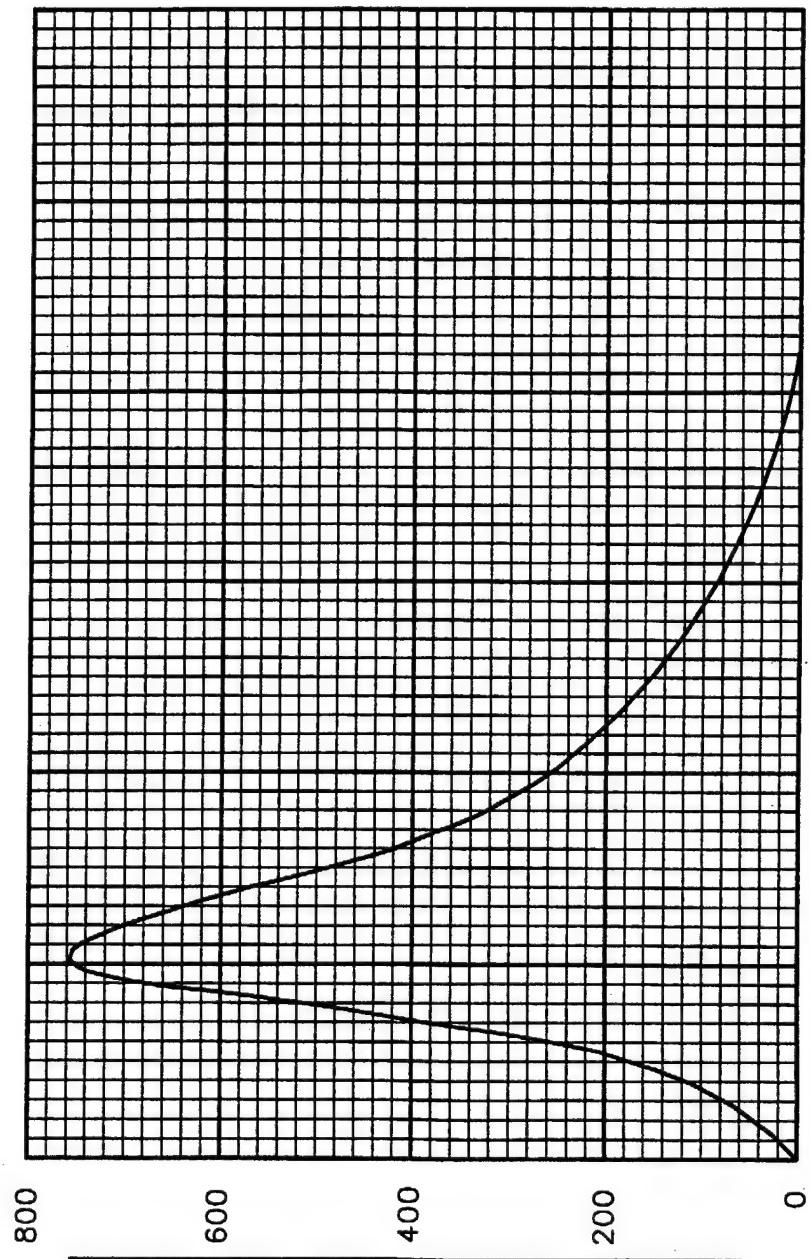
**30 MINUTE UNIT  
HYDROGRAPH**

DEER CREEK DAM AND RESERVOIR  
RAIL ROAD GRADE

| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |
|      |          |    |

**UNIT HYDROGRAPH PARAMETERS**

DA = 3.02 SQUARE MILES  
 L = 3.64 MILES  
 Lca = 0.85 MILES  
 Ct = 1.25  
 Tpr = 1.80  
 Qp = 757 CFS



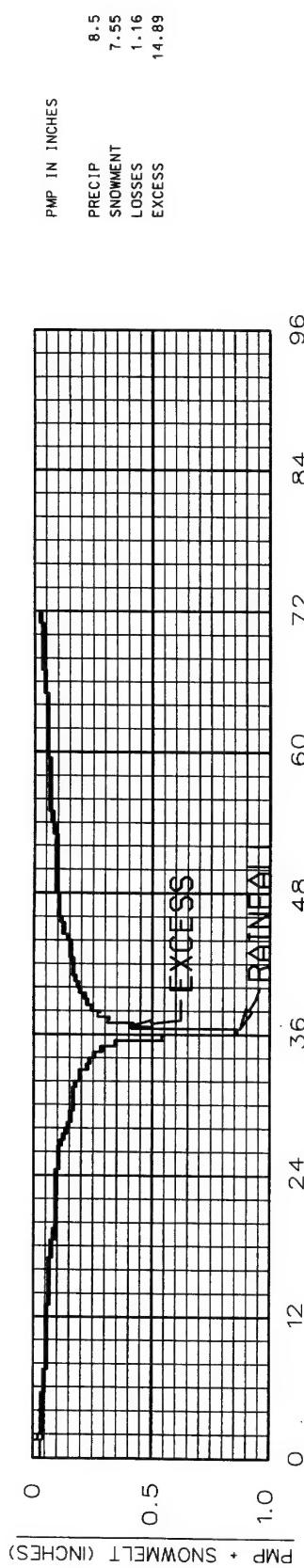
DISCHARGE IN CUBIC FEET PER SECOND

CHART 7

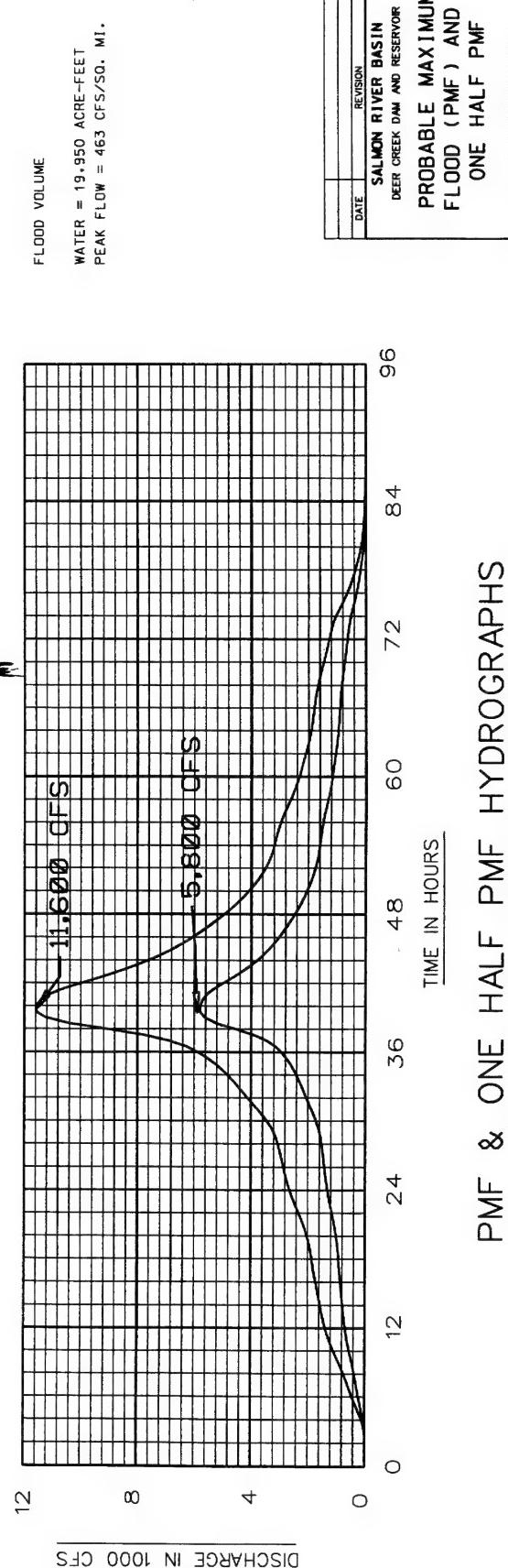
|                                                               |        |
|---------------------------------------------------------------|--------|
| U.S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH | DATE   |
| DESIGNED                                                      | DRAWN  |
| HEITSTUMAN                                                    | MAXSON |

U.S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH

DATE  
MARCH 1999



### PROBABLE MAXIMUM PRECIPITATION AND SNOWMELT



### PMF & ONE HALF PMF HYDROGRAPHS

| DATE                                                         | REVISION     |
|--------------------------------------------------------------|--------------|
| SALMON RIVER BASIN                                           | B7           |
| DEER CREEK DAM AND RESERVOIR                                 |              |
| PROBABLE MAXIMUM FLOOD (PMF) AND ONE HALF PMF                |              |
| U. S. ARMY ENGINEER DISTRICT, WALLA WALLA - HYDROLOGY BRANCH |              |
| DESIGNED HEITSTUMMAN                                         | DRAWN MAXSON |
| AD0603s                                                      | MARCH 1989   |

CHART 8

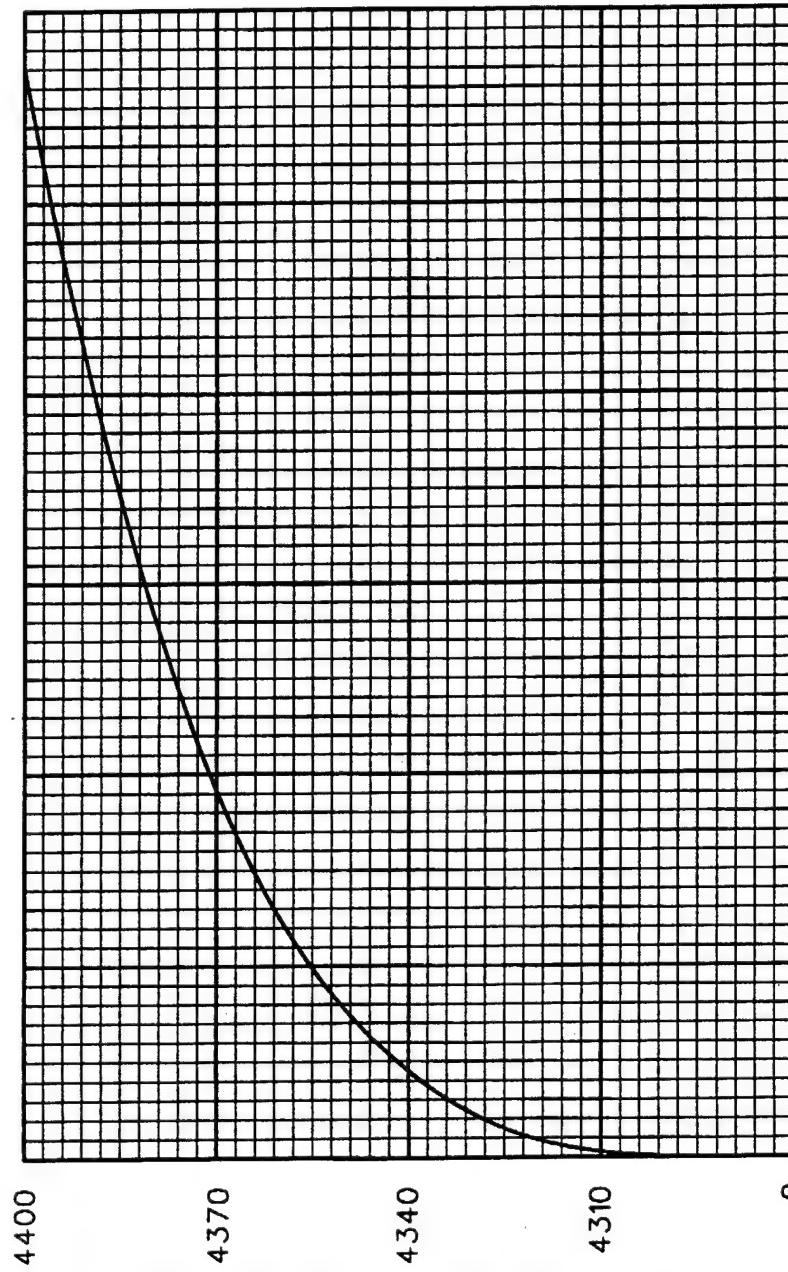
# STORAGE VS. ELEVATION CURVE

SALMON RIVER BASIN  
DEER CREEK DAM AND RESERVOIR

| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |
|      |          |    |

STORAGE IN ACRE-FEET

0      2000      4000      6000      8000      10000      12000



ELEVATION IN FEET (NAVD 1988)

U. S. ARMY ENGINEER DISTRICT  
WALLA WALLA - HYDROLOGY BRANCH  
DEER CREEK DAM AND RESERVOIR

AD0606  
HEITSTUMAN

DESIGNED DRAWN DATE  
MAXSON MARCH 1999

4360

4355

4350

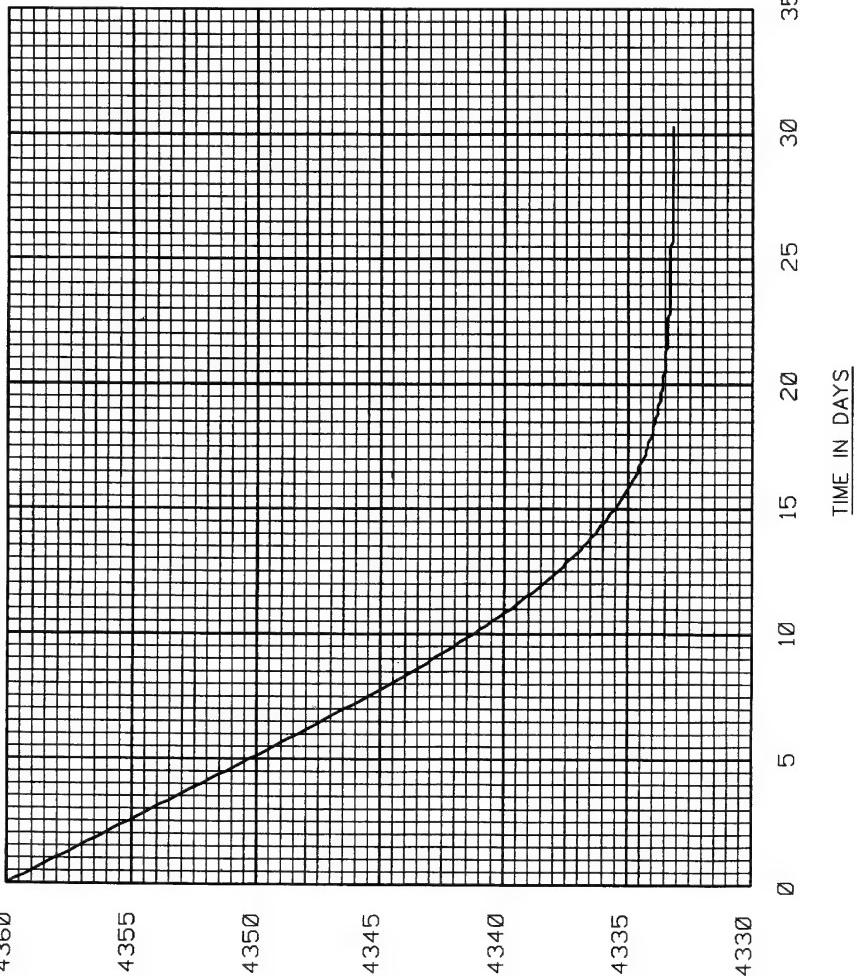
4345

4340

4335

4330

ELEVATION IN FEET NAVD 1988



NOTES:

1. DEER CREEK RESERVOIR DRAWDOWN BEGAN WITH THE POOL AT THE SPILLWAY CREST, 4360.0 FEET NAVD 1988.
2. INFLOW TO THE RESERVOIR DURING THE DRAWDOWN WAS A CONSTANT 50 CFS WHICH IS THE AVERAGE FLOW FOR THE APRIL THROUGH JULY PERIOD 110-2-50 DATED 22 AUGUST 1975, "LOW LEVEL DISCHARGE FACILITIES FOR DRAWDOWN OF IMPOUNDMENTS," SPECIFIES THAT AN INFLOW EQUAL TO THE AVERAGE FLOW OF THE HIGHEST CONSECUTIVE FOUR MONTH PERIOD SHOULD BE USED FOR DRAWDOWN ANALYSES.
3. NOTE THAT THE LOW LEVEL OUTLET CANNOT LOWER THE RESERVOIR BELOW ELEVATION 4333.2. AT THIS ELEVATION APPROXIMATELY 400 ACRE-FEET OF SEDIMENT AND 180 ACRE-FEET OF WATER REMAINS IN THE RESERVOIR FOR A TOTAL DEAD STORAGE OF 580 ACRE-FEET.
4. LOW LEVEL OUTLET RATING CURVE PROVIDED BY HYDRAULIC DESIGN SECTION, FEBRUARY 1999.

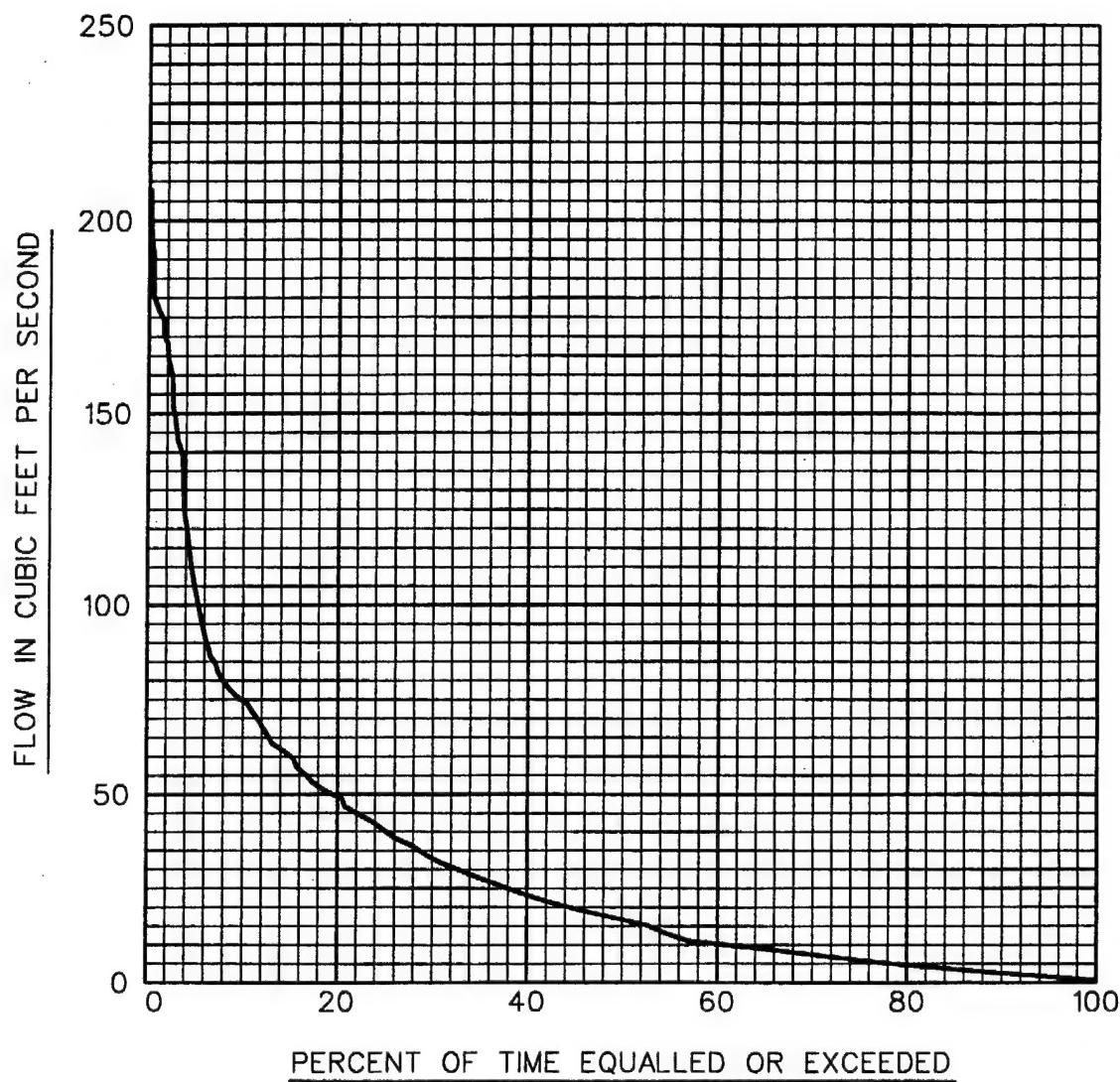
| DATE                         | REVISION | BY                 |
|------------------------------|----------|--------------------|
|                              |          | SALMON RIVER BASIN |
| DEER CREEK DAM AND RESERVOIR |          |                    |

DRAWDOWN CURVE

|                                                               |        |
|---------------------------------------------------------------|--------|
| U.S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH | DATE   |
| DESIGNED                                                      | DRAWN  |
| HEITSTUMAN                                                    | MAXSON |

ANCHORAGE  
MARCH 1999

CHART 10



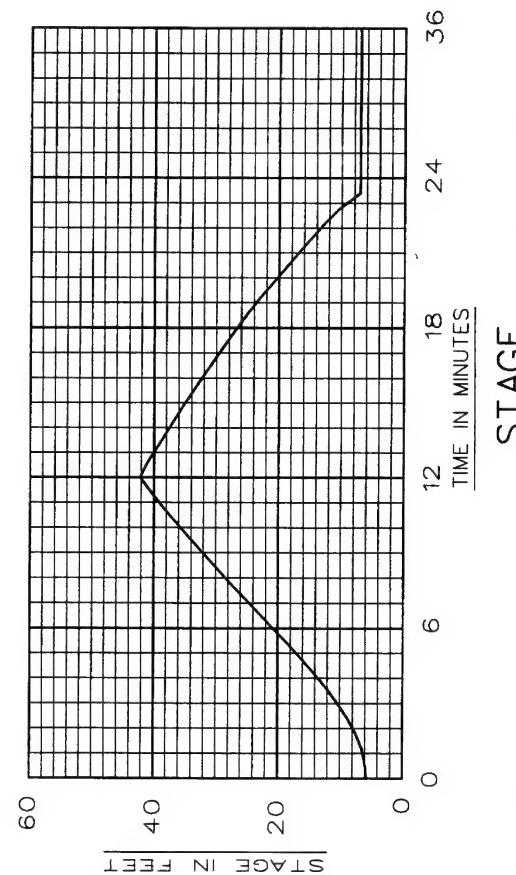
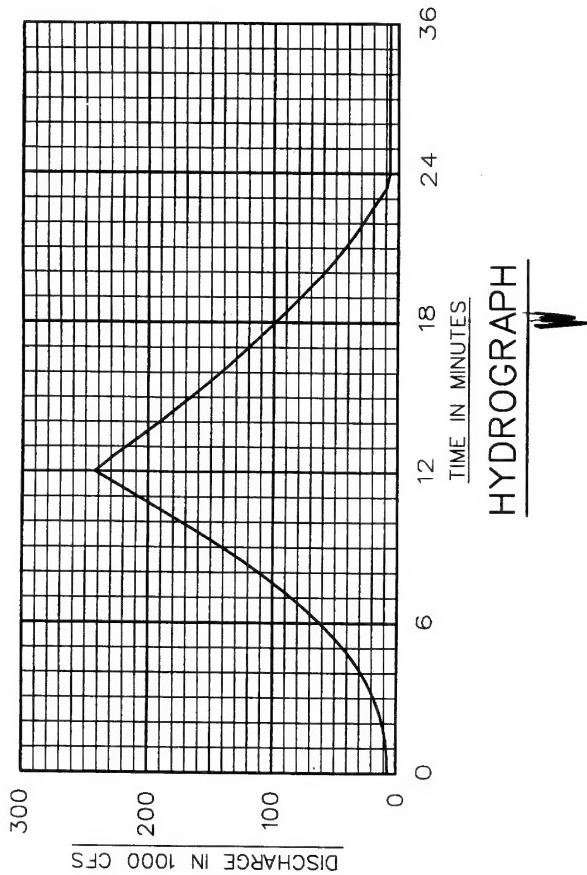
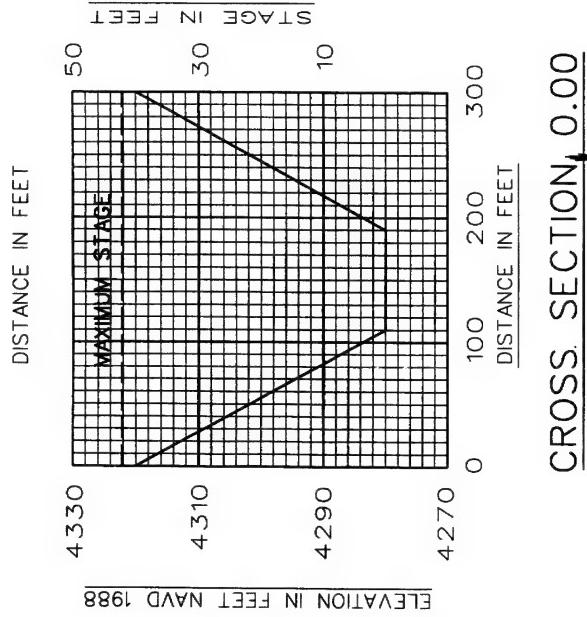
NOTES:

1. THE CURVE IS BASED ON UNITED STATES GEOLOGICAL SURVEY GAGING STATION NUMBER 13317500, DEER CREEK NEAR WINCHESTER, IDAHO MEAN DAILY DISCHARGE DATA FOR 1 APRIL THROUGH 31 JULY.
2. PERIOD OF RECORD FOR THIS CURVE IS: 1 OCTOBER 1951 THROUGH 30 NOVEMBER 1956.
3. THE PERIOD OF 1 APRIL THROUGH 31 JULY 1956 THE AVERAGE DAILY FLOW WAS APPROXIMATELY 44 CUBIC FEET PER SECOND.
4. THE CURVE REPRESENTS THE PERCENT OF TIME IN THE PERIOD OF RECORD THAT THE MEAN DAILY FLOW WAS EQUALLED OR EXCEEDED.

A00598

| DATE                                                           | REVISION        | BY                 |
|----------------------------------------------------------------|-----------------|--------------------|
| <b>SALMON RIVER BASIN</b>                                      |                 |                    |
| DEER CREEK NEAR WINCHESTER, IDAHO                              |                 |                    |
| <b>FLOW DURATION</b>                                           |                 |                    |
| <b>CURVE</b>                                                   |                 |                    |
| <b>APRIL THROUGH JULY</b>                                      |                 |                    |
| U. S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |                 |                    |
| DESIGNED<br>HEITSTUMAN                                         | DRAWN<br>MAXSON | DATE<br>MARCH 1999 |

CHART 11

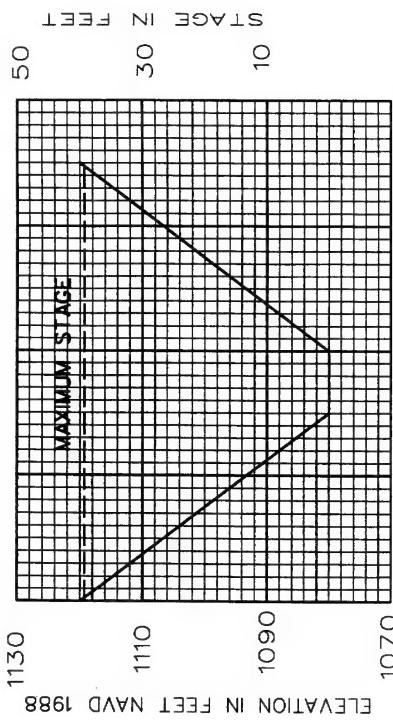


NOTES:

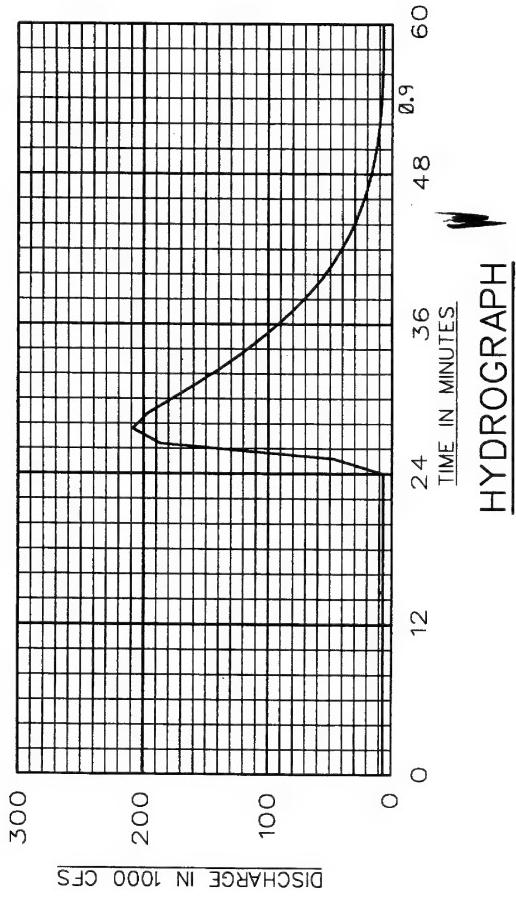
1. THE PEAK STAGE AT THIS CROSS SECTION IS 42.2 FEET.
2. THE PEAK DISCHARGE AT THIS CROSS SECTION IS 242,800 CFS

|                                                                |          |            |
|----------------------------------------------------------------|----------|------------|
| DATE                                                           | REVISION | BY         |
| SALMON RIVER BASIN<br>DEER CREEK DAM AND RESERVOIR             |          |            |
| DAM BREAK ANALYSIS                                             |          |            |
| CROSS SECTION AT DAM SITE                                      |          |            |
| (CROSS SECTION 0.00)                                           |          |            |
| U. S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |          | DATE       |
| DESIGNED                                                       | DRAWN    | MARCH 1999 |
| HEITSLUMAN                                                     | MAXSON   |            |

CHART 12



CROSS SECTION 6.72



HYDROGRAPH



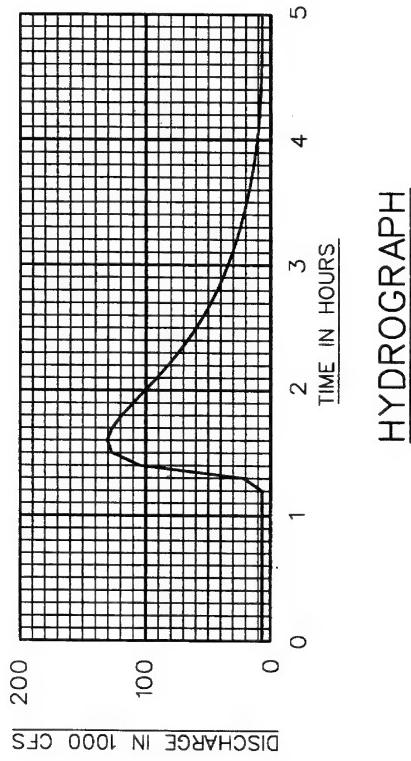
STAGE

NOTES:

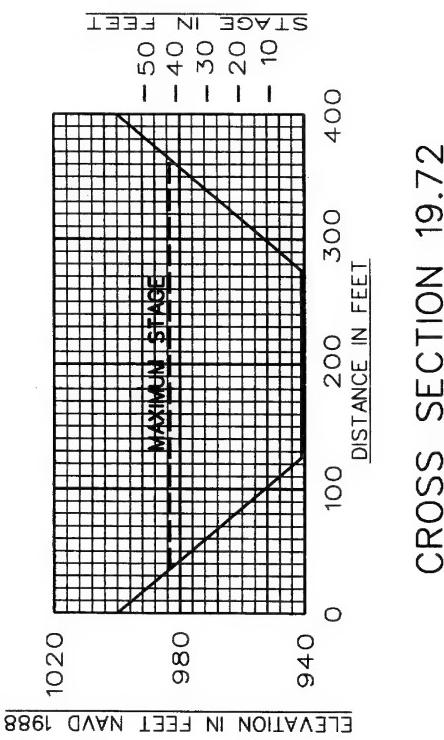
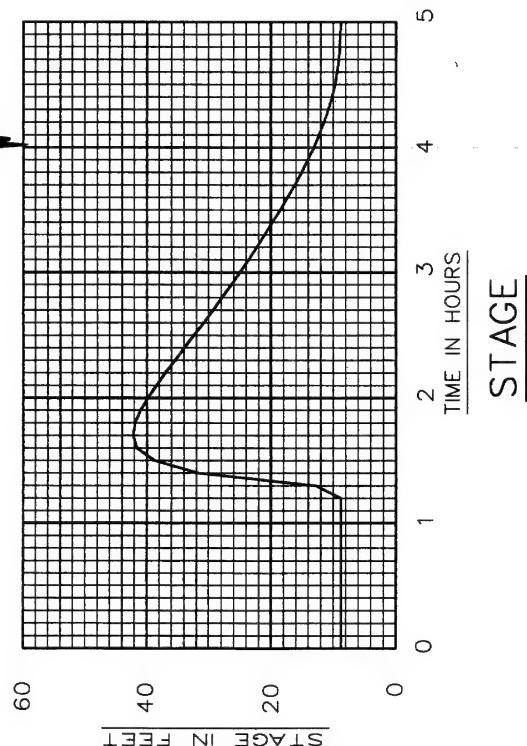
1. THE PEAK STAGE AT THIS CROSS SECTION IS 39.3 FEET
2. THE PEAK DISCHARGE AT THIS CROSS SECTION IS 208,800 CFS.

| DATE   | REVISION   | BY                           |
|--------|------------|------------------------------|
|        |            | SALMON RIVER BASIN           |
|        |            | DEER CREEK DAM AND RESERVOIR |
|        |            | DAM BREAK ANALYSIS           |
|        |            | CROSS SECTION AT MOUTH       |
|        |            | OF DEER CREEK                |
|        |            | (CROSS SECTION 6.72)         |
|        |            | U.S. ARMY ENGINEER DISTRICT  |
|        |            | WALLA WALLA HYDROLOGY BRANCH |
| A00609 | HEITSTUMAN | DRAWN                        |
|        |            | MAXSON                       |
|        |            | MARCH 1999                   |

CHART 13



HYDROGRAPH



CROSS SECTION 19.72

NOTES:

1. THE PEAK STAGE AT THIS CROSS SECTION IS 42.2.
2. THE PEAK DISCHARGE AT THIS CROSS SECTION IS 130,800

| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |
|      |          |    |
|      |          |    |

SALMON RIVER BASIN  
DEER CREEK DAM AND RESERVOIR  
DAM BREAK ANALYSIS  
CROSS SECTION AT MOUTH  
OF SALMON RIVER  
(CROSS SECTION 19.72)

U.S. ARMY ENGINEER DISTRICT  
WALLA WALLA HYDROLOGIC BRANCH

DESIGNED DRAWN DATE  
AD0610 HEITSTUMAN MASON MARCH 1999

CHART 14

4295

4293

4291

4289

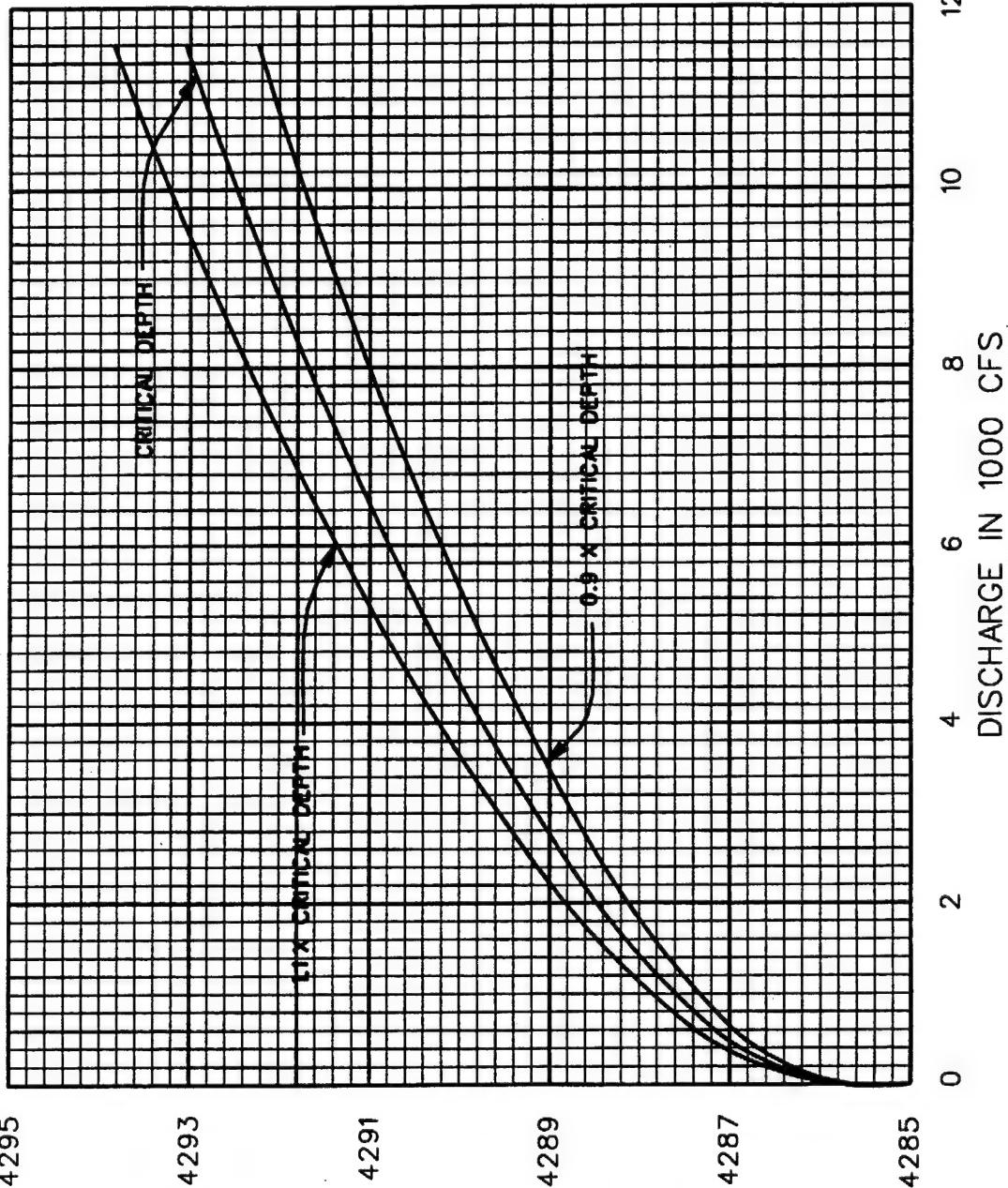
4287

4285

ELEVATION IN FEET NAVD 1988

## NOTES:

1. THE CROSS SECTION IS LOCATED APPROXIMATELY 110 FEET DOWNSTREAM OF THE AXIS OF THE DEER CREEK DAM SITE.
2. THE RATING CURVES ARE BASED ON THE EXISTING CONDITION PRIOR TO ANY EXCAVATION OR OTHER MODIFICATIONS.
3. BACKWATER COMPUTATIONS COMPUTE CRITICAL DEPTH FOR THE ENTIRE RANGE OF FLOW.



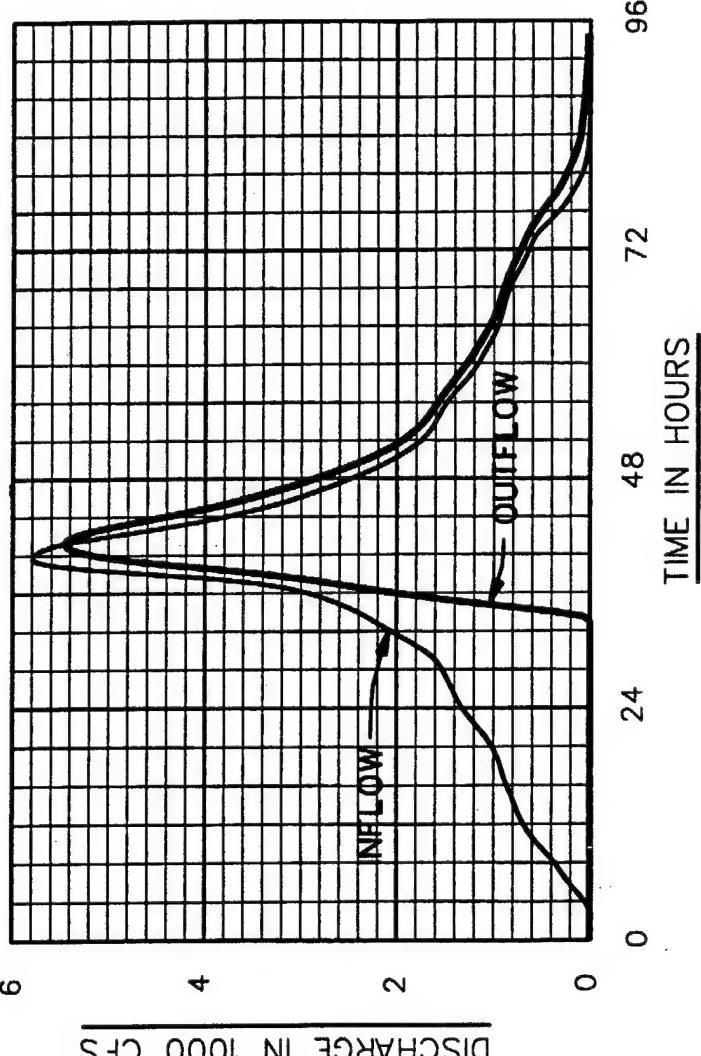
| DATE | REVISION | BY |
|------|----------|----|
|      |          |    |

**TAILWATER RATING  
CURVE**

| U.S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH |                 |                    |
|---------------------------------------------------------------|-----------------|--------------------|
| DESIGNED<br>AO0611<br>HEITSTUMAN                              | DRAWN<br>MAXSON | DATE<br>MARCH 1999 |

6

DISCHARGE IN 1000 CFS



## NOTES:

1. THE SPILLWAY WIDTH FOR THE RCC DAM IS 100 FEET.
2. THE SPILLWAY RATING CURVE WAS PROVIDED BY THE HYDRAULIC DESIGN SECTION.
3. THE PEAK INFLOW IS APPROXIMATELY 5,800 CFS. THE PEAK OUTFLOW IS APPROXIMATELY 5,460 CFS.
4. AT THE BEGINNING OF THE STORM THE RESERVOIR IS ASSUMED TO BE EMPTY.

|                                                                       |                 |                    |
|-----------------------------------------------------------------------|-----------------|--------------------|
| DATE                                                                  | REVISION        | BY                 |
|                                                                       |                 |                    |
|                                                                       |                 |                    |
|                                                                       |                 |                    |
|                                                                       |                 |                    |
| <b>SALMON RIVER BASIN</b>                                             |                 |                    |
| DEER CREEK DAM AND RESERVOIR                                          |                 |                    |
| <b>RCC DAM</b>                                                        |                 |                    |
| <b>ONE-HALF PROBABLE MAXIMUM FLOOD INFLOW AND OUTFLOW HYDROGRAPHS</b> |                 |                    |
| U. S. ARMY ENGINEER DISTRICT<br>WALLA WALLA - HYDROLOGY BRANCH        |                 |                    |
| DESIGNED<br>HEITSTUMAN                                                | DRAWN<br>MAXSON | DATE<br>MARCH 1999 |
| A00617                                                                |                 |                    |

## NOTES

1. THE SPILLWAY WIDTH FOR THE EMBANKMENT DAM IS 150 FEET.
  2. THE SPILLWAY RATING CURVE WAS PROVIDED BY THE HYDRAULIC DESIGN SECTION.
  3. THE PEAK INFLOW IS APPROXIMATELY 5,800 CFS. THE PEAK OUTFLOW IS APPROXIMATELY 5,630 CFS.
  4. AT THE BEGINNING OF THE STORM THE RESERVOIR IS ASSUMED TO BE EMPTY.

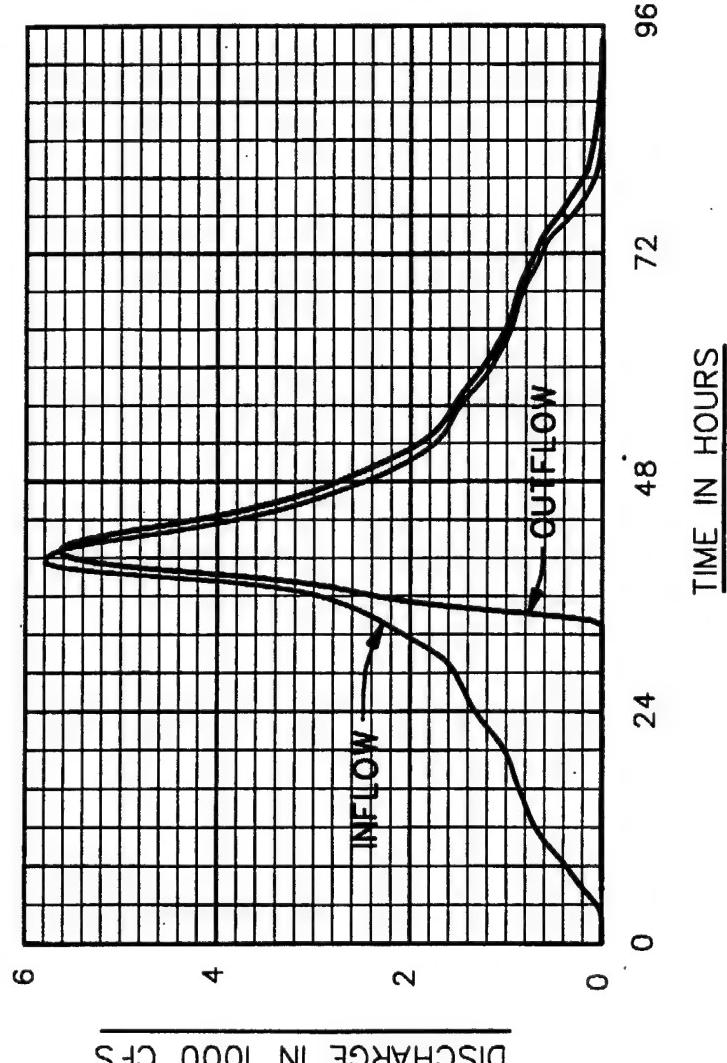


CHART 17

## **APPENDIX E**

### **Construction Schedule**

- 1. Construction Schedule for Embankment Dam Project**
- 2. Construction Schedule for RCC Dam Project**

## Construction Schedule for Embankment Dam Project

## Construction Schedule for Embankment Dam Project

| ID | Task Name                                    | Duration | Start    | Finish   | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |     |     |     |     |
|----|----------------------------------------------|----------|----------|----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-----|-----|-----|-----|
|    |                                              |          | Jan      | Feb      | Mar         | Apr         | May         | Jun         | Jul         | Aug         | Sep         | Oct         | Nov         | Dec         | Jan         | Feb         | Mar         | Apr         | May         | Jun         | Jul | Aug | Sep | Oct |
| 35 | Mob the first Season                         | 4 wks    | 4/16/01  | 5/11/01  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 36 | Demob the first Season                       | 3 wks    | 7/4/01   | 7/25/01  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 37 | Mob the Second Season                        | 4 wks    | 4/15/02  | 5/10/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 38 | Demob the Second Season                      | 3 wks    | 10/24/02 | 11/14/02 |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 39 | <b>STORAGE &amp; PONDING OF CONSTR WATER</b> | 22.7 wks | 5/13/02  | 10/17/02 |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 40 | Diversion Conduit Upper Dike                 | 1 wk     | 5/17/02  | 5/17/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 41 | Remove Diversion Upper Dike                  | 1 wk     | 10/10/02 | 10/17/02 |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 42 | <b>DIVERSION AND CARE OF WATER</b>           | 22.7 wks | 5/20/02  | 10/24/02 |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 43 | Diversion Conduit 48" Dia CMP                | 1 wk     | 5/20/02  | 5/24/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 44 | Remove Diversion Upper Dike                  | 1 wk     | 10/17/02 | 10/24/02 |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 45 | <b>SITE ACCESS &amp; HAUL ROADS</b>          | 0.5 wks  | 5/27/02  | 5/28/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 46 | Constr Road Grade Road Bed                   | 0.5 wks  | 5/27/02  | 5/29/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 47 | <b>FOUNDATION WORK</b>                       | 3.2 wks  | 5/29/02  | 6/20/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 48 | <b>EXCAVATION,UNCLASF</b>                    | 0.5 wks  | 5/29/02  | 5/31/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 49 | Excavation and Strip Foundation              | 0.5 wks  | 5/29/02  | 5/31/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 50 | <b>EXPLORATORY DRILLING</b>                  | 0.5 wks  | 6/3/02   | 6/5/02   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 51 | Nx Exploratory Drilling                      | 0.5 wks  | 6/3/02   | 6/5/02   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 52 | <b>PRESURE TESTING NX HOLE</b>               | 0.2 wks  | 6/5/02   | 6/6/02   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 53 | Presure Testing NX Hole                      | 0.2 wks  | 6/5/02   | 6/6/02   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 54 | <b>FOUNDATION CLEANUP</b>                    | 0.5 wks  | 6/6/02   | 6/10/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 55 | Foundation Cleanup                           | 0.5 wks  | 6/6/02   | 6/10/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 56 | <b>FOUND.TREAT.DRILL GROUT CURTAIN</b>       | 1 wk     | 6/11/02  | 6/17/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 57 | Drill Foundation Grout Curtain               | 1 wk     | 6/11/02  | 6/17/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 58 | <b>DENTAL CONCRETE</b>                       | 0.5 wks  | 6/18/02  | 6/20/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 59 | Dental Concrete                              | 0.5 wks  | 6/18/02  | 6/20/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 60 | <b>COMPACTED EARTH DAM</b>                   | 68.7 wks | 5/14/01  | 9/5/02   |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 61 | <b>IMPERVIOUS CORE MATERIAL (CH)</b>         | 10 wks   | 6/2/02   | 8/29/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 62 | Load, Haul, Place Imperious Mat              | 10 wks   | 6/20/02  | 8/29/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 63 | <b>SAND FILTER, (10' THICK)</b>              | 65.7 wks | 5/14/01  | 8/15/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 64 | Crushing & Stockpile Materials               | 2 wks    | 5/14/01  | 5/25/01  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 65 | Load, Haul & Place Sand Filter               | 8 wks    | 6/20/02  | 8/15/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 66 | <b>COBBLE BEDDING,(9" THICK GRAVEL)</b>      | 65.7 wks | 5/28/01  | 8/29/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 67 | Crushing & Stockpile Materials               | 0.5 wks  | 5/28/01  | 5/30/01  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |
| 68 | Load, Haul & Place Gravel Filter             | 10 wks   | 6/20/02  | 8/29/02  |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |             |     |     |     |     |

## Construction Schedule for Embankment Dam Project

| ID  | Task Name                         | Duration |         | Start    | Finish | 1st Quarter |      |     | 2nd Quarter |     |     | 3rd Quarter |     |     | 4th Quarter |  |  |
|-----|-----------------------------------|----------|---------|----------|--------|-------------|------|-----|-------------|-----|-----|-------------|-----|-----|-------------|--|--|
|     |                                   | Jan      | Feb     |          |        | Mar         | Apr. | May | Jun         | Jul | Aug | Sep         | Oct | Nov | Dec         |  |  |
| 69  | COBBLE 18"THICK SLOPE PROTECTION  | 66.2 wks | 5/30/01 | 9/5/02   | 6/6/01 | 6/6/01      |      |     |             |     |     |             |     |     |             |  |  |
| 70  | Crushing & Stockpile Materials    | 1 wk     | 5/30/01 |          |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 71  | Load/Haul & Dumping Cobble Rocks  | 10 wks   | 6/20/02 |          |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 72  | Placing and Keying in Cobbles     | 1 wk     | 8/29/02 |          |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 73  | RIPRAP BEDDING,(12"THICK GRAVEL)  | 64.2 wks | 6/6/01  | 8/29/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 74  | Crushing & Stockpile Materials    | 1 wk     | 6/6/01  | 6/13/01  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 75  | Load,Haul & Place Riprap Bedding  | 10 wks   | 6/20/02 | 8/29/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 76  | RIPRAP 30"THICK SLOPE PROTECTION  | 63. wks  | 6/13/01 | 8/30/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 77  | Crushing & Stockpile Materials    | 3 wks    | 6/13/01 | 7/4/01   |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 78  | Load, Haul & Dumping Riprap       | 10 wks   | 6/20/02 | 8/29/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 79  | Placing and Keying in Riprap      | 0.2 wks  | 8/29/02 | 8/30/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 80  | SPILLWAY                          | 11 wks   | 5/29/02 | 8/14/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 81  | EXCAVATION,UNCLASF                | .5 wks   | 5/29/02 | 5/31/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 82  | Excavation and Strip Foundation   | 0.5 wks  | 5/29/02 | 5/31/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 83  | EXCAVATION,ROCK EXCAVATION        | 3 wks    | 6/2/02  | 6/2/02   |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 84  | Rock Drill, Shot & Producing      | 1 wk     | 6/3/02  | 6/7/02   |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 85  | Precipit Rock, Drill, & Shot      | 1 wk     | 6/10/02 | 6/14/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 86  | Load & Haul Ripped & Blasted Rock | 1 wk     | 6/17/02 | 6/21/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 87  | FOUNDATION CLEANUP                | 0.5 wks  | 6/24/02 | 6/26/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 88  | Foundation Cleanup                | 0.5 wks  | 6/24/02 | 6/26/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 89  | CONCRETE OVERFLOW SECTION         | 7 wks    | 6/26/02 | 8/14/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 90  | Concrete Overflow Section         | 4 wks    | 6/26/02 | 7/24/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 91  | Concrete Retaining Wall Slabs     | 1 wk     | 7/24/02 | 7/31/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 92  | Concrete Retaining Walls          | 2 wks    | 7/31/02 | 8/14/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 93  | OUTLET WORKS                      | 19.7 wks | 5/27/02 | 10/10/02 |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 94  | CONCRETE OUTLET&IMPACT BASIN STR  | 5.5 wks  | 5/28/02 | 7/16/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 95  | Concr.Impact Basin Slab           | 2 wks    | 5/28/02 | 6/12/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 96  | Concr.Impact Basin Wall & Battie  | 2 wks    | 6/12/02 | 6/26/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 97  | Concr Impact Basin Precast Slab   | 1 wk     | 6/26/02 | 7/3/02   |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 98  | Outlet Channel Rip Rap,20" Thick  | 0.5 wks  | 7/3/02  | 7/5/02   |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 99  | OUTLET CONDUIT ( 48" DIA. PIPE )  | 0.5 wks  | 5/27/02 | 5/29/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 100 | Outlet Conduit ( 48" Dia. Pipe )  | 0.5 wks  | 5/27/02 | 5/29/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 101 | INTAKE STRUCTURE                  | 19.2 wks | 5/29/02 | 10/10/02 |        |             |      |     |             |     |     |             |     |     |             |  |  |
| 102 | Intake Tower Foundation Slab      | 2 wks    | 5/29/02 | 6/12/02  |        |             |      |     |             |     |     |             |     |     |             |  |  |

## Construction Schedule for Embankment Dam Project

| ID  | Task Name                         | Duration | 1st Quarter |          |     | 2nd Quarter |     |     | 3rd Quarter |     |     | 4th Quarter |     |     |
|-----|-----------------------------------|----------|-------------|----------|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|
|     |                                   |          | Jan         | Feb      | Mar | Apr         | May | Jun | Jul         | Aug | Sep | Oct         | Nov | Dec |
| 103 | Intake Tower Walls                | 2 wks    | 6/12/02     | 6/26/02  |     |             |     |     |             |     |     |             |     |     |
| 104 | Intake Tower Elevated Slab        | 2 wks    | 6/26/02     | 7/10/02  |     |             |     |     |             |     |     |             |     |     |
| 105 | Intake Gate Controller Slab       | 2 wks    | 8/29/02     | 9/12/02  |     |             |     |     |             |     |     |             |     |     |
| 106 | Intake Tower Control Room         | 2 wks    | 9/12/02     | 9/26/02  |     |             |     |     |             |     |     |             |     |     |
| 107 | Intake Tower Trashtracks          | 1 wk     | 9/26/02     | 10/3/02  |     |             |     |     |             |     |     |             |     |     |
| 108 | 24" x 24" Slide Gate & Controller | 0.5 wks  | 10/3/02     | 10/7/02  |     |             |     |     |             |     |     |             |     |     |
| 109 | 12" Dia. Vent Pipe                | 0.5 wks  | 10/6/02     | 10/10/02 |     |             |     |     |             |     |     |             |     |     |

## Construction Schedule for RCC Dam Project

| ID | Task Name                          | Time Restrictions | 1st Quarter |     |     | 2nd Quarter |     |     | 3rd Quarter |     |     | 4th Quarter |     |     | 1st Quarter |     |     | 2nd Quarter |     |     | 3rd Quarter |     |     |     |     |
|----|------------------------------------|-------------------|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-----|-----|
|    |                                    |                   | Jan         | Feb | Mar | Apr         | May | Jun | Jul         | Aug | Sep | Oct         | Nov | Dec | Jan         | Feb | Mar | Apr         | May | Jun | Jul         | Aug | Sep | Sep | Oct |
| 1  | Project Construction Start         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 2  | First Winter Shut Down             |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 3  | Second Season Start                |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 4  | RESERVOIRS                         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 5  | CLEARING AND DEBRIS REMOVAL        |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 6  | Clear, Grub, My Brush & Lgh Trees  |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 7  | Cr. H-Brush W/Avg Grub M/H-Trees   |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 8  | RESERVOIRS                         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 9  | ACCESS ROADS                       |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 10 | ROADS                              |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 11 | FOREST ROAD, IMPROVE EXISTING(A)   |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 12 | START WORK                         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 13 | FOREST ROAD, PREP FOR SURFACING    |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 14 | FOREST ROAD, CRUSH'D SURFACING MAT |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 15 | FOREST ROAD, 4' BASE COURSE        |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 16 | FOREST ROAD, 2' TOP COURSE         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 17 | NEW PERM SITE ACCESS ROADS (B)     |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 18 | ACCESS ROAD, CRUSH'D SURFACING MAT |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 19 | ACCESS ROAD, 4' BASE COURSE        |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 20 | ACCESS ROAD, PREP FOR SURFACING    |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 21 | ACCESS ROAD, 1' TOP COURSE         |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 22 | ACCESS ROAD, CULVERTS-16"(5 EACH)  |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 23 | ACCESS ROAD, 0.2 wks               |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 24 | ACCESS ROAD, 0.5 wks               |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 25 | ACCESS ROAD, 16 wks                |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 26 | ACCESS ROAD, CRUSH'D SURFACING MAT |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 27 | ACCESS ROAD, 1 wk                  |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 28 | ACCESS ROAD, 0.5 wks               |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 29 | ACCESS ROAD, 0.5 wks               |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 30 | FINISH WORK                        |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 31 | ROLLER COMPACTED CONCRETE DAM      |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 32 | SITE PREP                          |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 33 | 77.7 wks                           |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 34 | MOB., DEMOB., AND PREWORK          |                   |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |

## Construction Schedule for RCC Dam Project

| ID | Task Name                                    | 1st Quarter |     |     |     | 2nd Quarter |     |     |     | 3rd Quarter |     |     |     | 4th Quarter |     |     |     | 1st Quarter |     |     |     | 2nd Quarter |     |     |     | 3rd Quarter |     |     |  |  |
|----|----------------------------------------------|-------------|-----|-----|-----|-------------|-----|-----|-----|-------------|-----|-----|-----|-------------|-----|-----|-----|-------------|-----|-----|-----|-------------|-----|-----|-----|-------------|-----|-----|--|--|
|    |                                              | Jan         | Feb | Mar | Apr | May         | Jun | Jul | Aug | Sep         | Oct | Nov | Dec | Jan         | Feb | Mar | Apr | May         | Jun | Jul | Aug | Sep         | Sep | Oct | Oct | Sep         | Sep | Oct |  |  |
| 35 | Mob the first Season                         |             |     |     |     | 4 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 36 | Demob the first Season                       |             |     |     |     | 3 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 37 | Mob the Second Season                        |             |     |     |     | 4 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 38 | Demob the Second Season                      |             |     |     |     | 3 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 39 | <b>STORAGE &amp; PONDING OF CONSTR WATER</b> |             |     |     |     | 17.7 wks    |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 40 | Diversion Conduit Upper Dike                 |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 41 | Remove Diversion Upper Dike                  |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 42 | <b>DIVERSION AND CARE OF WATER</b>           |             |     |     |     | 17.7 wks    |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 43 | Diversion Conduit 48" Dia CMP                |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 44 | Remove Diversion Upper Dike                  |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 45 | <b>SITE ACCESS &amp; HAUL ROADS</b>          |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 46 | Constr Road Grade Road Bed                   |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 47 | <b>FOUNDATION WORK</b>                       |             |     |     |     | 3.2 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 48 | <b>EXCAVATION,UNCLASF</b>                    |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 49 | Excavation and Strip Foundation              |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 50 | <b>EXPLORATORY DRILLING</b>                  |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 51 | Nx Exploratory Drilling                      |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 52 | <b>PRESURE TESTING NX HOLE</b>               |             |     |     |     | 0.2 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 53 | Presure Testing NX Hole                      |             |     |     |     | 0.2 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 54 | <b>FOUNDATION CLEANUP</b>                    |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 55 | Foundation Cleanup                           |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 56 | <b>FOUND,TREAT,DRILL GROUT CURTAIN</b>       |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 57 | Drill Foundation Grout Curtain               |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 58 | <b>DENTAL CONCRETE</b>                       |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 59 | Dental Concrete                              |             |     |     |     | 0.5 wks     |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 60 | <b>ROLLER COMPACTED CONCRETE DAM</b>         |             |     |     |     | 68.7 wks    |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 61 | <b>RCC TEST PLACEMENT</b>                    |             |     |     |     | 2 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 62 | RCC Concrete,1 Test Slab,5 Strip             |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 63 | Remove RCC Conc.,1 Slab,5 Strip              |             |     |     |     | 1 wk        |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 64 | <b>RCC CONCRETE</b>                          |             |     |     |     | 65.7 wks    |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 65 | RCC Conc,Crushing & Stockpile Mat            |             |     |     |     | 4 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 66 | RCC Conc., Placing RCC Mix                   |             |     |     |     | 8 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 67 | <b>SPILLWAY TRAINING WALLS</b>               |             |     |     |     | 3 wks       |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |
| 68 |                                              |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |     |             |     |     |  |  |

## Construction Schedule for RCC Dam Project

| ID | Task Name                         | Duration |     |     | 1st Quarter |     |     | 2nd Quarter |     |     | 3rd Quarter |     |     | 4th Quarter |     |     | 1st Quarter |     |     | 2nd Quarter |     |     | 3rd Quarter |     |     | 4th Quarter |     |     |     |     |
|----|-----------------------------------|----------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-------------|-----|-----|-----|-----|
|    |                                   | Jan      | Feb | Mar | Apr         | May | Jun | Jul         | Aug | Sep | Oct         | Nov | Dec | Jan         | Feb | Mar | Apr         | May | Jun | Jul         | Aug | Sep | Oct         | Nov | Dec | Jan         | Feb | Mar | Apr | May |
| 69 | Spillway Tr/Wall Conc Spill Wall  | 1 wk     |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 70 | Spillway Tr/Wall Conc Basin Slab  | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 71 | VERT. FACING SYSTEM DAM           | 9 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 72 | Vert.Facing System, Starter Slab  | 1 wk     |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 73 | Vert.Facing System                | 8 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 74 | SPILLWAY CAP CONCRETE             | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 75 | Spillway Cap, Overflow Conc Wier  | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 76 | OUTLET WORKS                      | 11.7 wks |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 77 | CONCRETE OUTLET&IMPACT BASIN STR  | 5.5 wks  |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 78 | Concr.Impact Basin Slab           | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 79 | Concr.Impact Basin Wall & Baffle  | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 80 | Concr.Impact Basin Precast Slab   | 1 wk     |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 81 | Outlet Channel Rip Rap,20" Thick  | 0.5 wks  |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 82 | OUTLET CONDUIT ( 48" Dia. PIPE )  | 0.2 wks  |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 83 | Outlet Conduit ( 48" Dia. Pipe )  | 0.2 wks  |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 84 | INTAKE STRUCTURE                  | 11.5 wks |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 85 | Intake Tower Foundation Slab      | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 86 | Intake Tower Walls                | 3 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 87 | Intake Tower Elevated Slab        | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 88 | Slide Gate Controller Slab        | 1 wk     |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 89 | Intake Tower Trashracks           | 2 wks    |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 90 | 24" x 24" Slide Gate & Controller | 1 wk     |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 91 | 12" Dia. Vent Pipe                | 0.5 wks  |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |
| 92 |                                   |          |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |             |     |     |     |     |

## **APPENDIX F**

### **References**

## APPENDIX F

### References

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